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ABSTRACT

Adapted from the Vocational-Technical Education Consortium of States (V-TECS) catalog, this comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and other data relating to construction plumbing and maintenance plumbing was prepared for use in vocational programs in South Carolina. Each performance objective contains the condition under which the student will perform the objective, the performance required of the student after instruction has taken place, and a job-relevant standard for measuring successful performance of the objective. The source of the standard for each objective is documented from one of the following three sources: job-based information provided in technical manuals, certification requirements, or other germane literature; the level of performance agreed upon by incumbent workers and supervisors who served on the writing team or as consultants to the team; and the subject matter specialists who served on the writing team. The source of the standard is identified in parentheses after each performance objective. A criterion-referenced measure follows each performance objective and is designed to test student achievement of the objective. The performance guides which accompany most of the objectives and measures are procedural steps identified as subordinate to task performance. Only one performance guide is given per item. Literature sources and a cross reference table are included in the appendixes. (BM)

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A Catalog of Performance Objectives, Criterion Referenced Measures and Performance Guides

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PLUMBING

CE 013 886

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I. INTRODUCTION

This catalog of performance objectives, criterion referenced measures and performance guides was adapted from the V-TECS catalog developed in Mississippi. A committee of plumbing teachers composed of Homer C. Crow, Vernon E. Willis and James P. Herrin, assisted by Mr. James Wright, District 3 T & I Consultant, A. K. Jensen and R. T. Benson, Vocational Education Media Center, A. F. Newton and F. A. Bosdell of the Industrial Education Department, have reviewed the original catalog and prepared this document for use in plumbing programs in South Carolina.

II. DEFINITION OF TERMS

Catalog. A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data, organized by a job structure or career ladder within a domain of interest.

Criterion-Referenced Measure. An exercise based upon a performance objective and designed to measure attainment of that objective. It possesses each of the characteristics specified below:

a. Congruence–The task specified in the item corresponds directly to the performance specified in the objective.

b. Comprehensibility–The item is so stated or portrayed that the learner clearly understands what is expected.

c. Objectivity–The exercise is stated in such a way that all competent observers can make a clear and unequivocal decision as to whether or not the learner has demonstrated an acceptable performance.

d. Integrity–The exercise is structured in such a way that an acceptable response to the exercise constitutes sufficient evidence, in and of itself, that the learner has accomplished the corresponding objectives.

Domain. A cluster of related jobs.

D.O.T. Code. A nine-digit number used to identify a specific job within a given domain, taken from the Dictionary of Occupational Titles.[1]

Duty. One of the distinct major activities involved in the work performed, comprising related tasks.

Educational Consortium. A group of state agencies, institutions, or other entities which have been legally constituted through letters of commitment, agreements, or by assignments of high authorities to work together toward the solution of problems in education. A membership from autonomous agencies and institutions which cut across state boundaries as they attempt to solve problems or meet goals.

Job. The duties and tasks actually performed by a specific individual.

Job Inventory. A listing of tasks to be performed in a particular occupational area, grouped under duty classifications. Also called "task list."

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[1] Also see Vocational Education and Occupations (July, 1969) (Washington: Government Printing Office, Catalog FS 5.280:80061, 1969).

Occupational Education. An organized sequence of learning experiences consisting of vocational theory, practice, and skill for students on a regular or systematic basis.[2]

O. E. Code. A six-digit number used to identify a specific domain.[3]

Performance Guide. A series of steps arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also called "teaching steps."

Performance Objective. A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It states the testing condition (situation) confronting the learner, the specific performance expected of the learner, and the standard of acceptable performance.

Task. A unit of work activity or operation that constitutes a logical and necessary step in the performance of a duty.

Task Analysis. A process of reviewing actual job content in business and industry for application to the development of performance objectives, criterion-referenced measures, and quality control within a program of vocational-technical education.

Task Criticality. A characteristic of a task statement which makes its accomplishment crucial to the acceptable performance of a worker or student. A method of analysis which identifies the critical tasks and aids in determining the consequence of poor performance or lack of performance by a worker or student.

Task Difficulty Index. An index used to determine the relative difficulty of each task performed within the domain of interest. This information is collected from selected workers and their immediate supervisors.

Task List. A listing of tasks performed by incumbent workers within a domain of interest. An example is a listing of all tasks performed by a plumber.

Task Time-Spent Index. An index of relative time spent on each task within a domain of interest and appearing on a task list. The task time-spent index is computed from selected samples of incumbent workers who respond to task listings.

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[2] Standards of the Delegate Assembly (Atlanta: Southern Association of Colleges and Schools, Commission on Occupational Education, December, 1972), p. 12.

[3] V.E.O. (op. cit.).

III. PURPOSE OF CATALOG

This catalog is designed to provide job-relevant performance objectives, criterion-referenced measures, and performance guides relating to the job content of construction plumbing and maintenance plumbing. It may serve many functions, including the following:

1. Objectives may be compared to existing programs for possible inclusion.

2. Performance guides may be used as a blueprint for designing curriculum/instructional materials which will support selected objectives.

3. Criterion-referenced measures may be used to test the effectiveness of instruction in terms of measurable student achievement.

4. Criterion-referenced measures may also be used to determine entering student competencies, thus allowing for advanced student placement and individualization of instruction.

5. Measurement outcomes may be used to accept, improve, or reject an instructional procedure or system.

6. Performance guides may be used as teaching points for the instructor, who may choose to develop supporting instructional materials.

For those who wish to develop supporting instructional materials in plumbing, the following suggestions are offered:

1. Identify the performance objectives which will be included in the program of instruction.

2. Study the plumbing information presented in the catalog for each objective selected. This information will serve as a basis for determining the additional information needed. It may be necessary to combine more than one objective for inclusion in a learning unit, or to modify objectives which are not realistic for local school/student needs.

3. Develop or compile detailed student learning units. The units should be self-instructional in design, and written around one or a few select performance objectives. The following elements should be included in each learning unit:

   a. Pre-test, similar to the criterion-referenced measure presented in the catalog.

   b. Performance objectives.

   c. Instructions to students, including what to do in acquiring knowledge about the performance objectives, and what to do in performing the task cited in the objective. The latter would be a detailed performance guide based upon the guide presented in the catalog.

   d. Information sheets, if not already available. Appropriate photographs or illustrations should also be included.

   e. Post-test (identical to or parallel with the pre-test).

4. Write an instructor plan on what is contained in the student-centered curriculum and how to manage the use of the learning units. Include a description of how the program will accommodate student learning/skill options and by-passes of skills already possessed, as determined by a pre-test.

IV. DEVELOPMENT OF CATALOG

The methodology used in developing the catalog of performance objectives, criterion-referenced measures, and performance guides in plumbing is described in the following paragraphs.

Preliminary Research

A state-of-the-art study of plumbing training was conducted as a first step in establishing the validity of this catalog. The state-of-the-art study resulted in preliminary listings of plumbing tasks and a collection of written texts for project reference. The state-of-the-art study is available upon request from the Research and Curriculum Unit for Vocational-Technical Education (R/CU) at Mississippi State University.

Then, a representative group of eight master plumbers were selected and interviewed by the project staff to develop a complete list of tasks performed in the plumbing industry. The task inventory and tool/equipment list were arranged in questionnaire form and used to collect additional information from a sample of plumbers in Mississippi. A copy of this inventory is available upon request from the R/CU.

Description of Sample and Survey of Plumbers

There are approximately 510 plumbing establishments in Mississippi which employ approximately 1,655 workers. These include construction firms and plumbing maintenance departments in business, industry and institutions.

Three task inventories were mailed to 56 plumbing establishments to reach a required sample size of 180 plumbers. Survey inventories which were unused and returned due to insufficient workers at the employment sources were reused with replacement numbers. The survey yielded 154 useable returns. The reliability of the information collected from the workers, as determined by Coefficient Alpha, was .93693. This means that worker responses to the tasks included in the inventory were highly consistent. Each respondent in the survey checked the tasks he performed, the relative amount of time spent performing each task, and equipment used. Workers added tasks which were not included in the inventory.

Respondents to the survey were classified under one of the following Dictionary of Occupational Titles:

1. Plumber 862.381-074.

2. Maintenance Plumber 862.381-082.

A detailed description of the sample of workers is available upon request from the R/CU.

Analysis of Data

Computer analyses of the data collected from the sample of workers were performed by V-TECS, and the printouts were provided to the state project staff for interpretation. Reports were provided, as follows:

1. Index of time spent performing tasks
2. Differential of time-spent by construction plumbers and maintenance plumbers
3. Standard deviation of time-spent values
4. Duty/task list
5. Percentage of workers performing tasks
6. Equipment used by workers
7. Equipment used by percentage rating (See Appendix A.)

The consortium maintains a data bank of catalog information. Data includes tasks, performance objectives, criterion-referenced measures and performance guides from each catalog produced by member states. Retrieval of all or part of this information is available by D.O.T. and O.E. codes upon request by individuals or agencies from within consortium states.

Based upon a study of these reports, performance objectives and criterion-referenced measures were written. The following procedures were used to select or reject tasks for further development:

1. Tasks which were performed by 30 percent or more of the workers were generally accepted for further development.
2. Tasks were analyzed in terms of the time-spent index. This meant accepting some tasks performed by fewer than 30 percent of the workers, and rejecting some tasks which were performed by more than 30 percent of the workers.
3. Tasks which were below the 30 percent cut-off were analyzed for criticality, using incumbent workers.
4. Tasks were analyzed in terms of difficulty. This meant that some tasks above the 30 percent cut-off were rejected because of minimum skill requirements.

The Writing Team

Two instructional materials specialists in trade and industrial education were assigned to the project. They were charged with the responsibility of interpreting the survey data and writing the catalog of performance objectives, criterion-referenced measures, and performance guides. In the absence of detailed performance information from technical literature, it was necessary to go to the field and interview master plumbers. Key information was compiled from interviews with 15 plumbers and converted into performance objectives, criterion-referenced measures, and performance guides. The Mississippi Plumbing-Heating-Cooling Contractor's Association cooperated in identifying master plumbers with experience in on-the-job training.

Tasks for which questionable information was provided were analyzed by more than one worker in an effort to gain a concensus. The task information was compared by the instructional materials specialists and combined into one objective.

A vocational instructor in plumbing was selected to review all work completed by the instructional materials specialists. His review of the catalog was performed at the R/CU under the guidance and supervision of the instructional materials specialists. Following this review, revisions were made as necessary and the field review catalog was completed.

The Field Review

The purpose of the field review of the catalog was to gather data and additional information from master plumbers, apprentice training coordinators, curriculum specialists, and vocational supervisors in the field. The data was used as a basis for improving certain objectives before they were utilized in the classroom. The field review was necessary because the performance objectives, criterion-referenced measures, and performance guides were prepared by a small team of writers. The field review made it possible to gather input from a larger number of people, 25 of whom participated in the review.

V. ELEMENTS OF THE CATALOG

The catalog is comprised of performance objectives, associated criterion-referenced measures, and performance guides which were prepared from job-related task statements in the occupational inventory.

Each performance objective contains the following elements: (1) the condition under which the student will perform the objective, (2) the performance required of the student after instruction has taken place, and (3) a job-relevant standard for measuring successful performance of the objective. The source of the standard for each objective is documented from one of the three sources outlined below:

1. The primary source of performance standards is job-based information provided in technical manuals, certification requirements, or other germane literature.

2. The secondary source of performance standards is the level of performance agreed upon by incumbent workers and supervisors who served on the writing team or as consultants to the team.

3. The third source of performance standards is the writing team, composed of the subject matter specialists. However, specialists were used as resources only when the first two sources were unavailable.

The source of the standard is identified in parentheses after each performance objective, i.e., (1) or (3, 10). The first number in the parenthesis refers to a source identified in the List of References (Appendix B) and the second number, if cited, refers to the page number. Listing of a reference in no way implies that this is the only source of an appropriate standard and certainly should not be construed as a blanket endorsement of the organization or publication from which the standard was secured. There may be other valid sources in addition to the one cited.

The criterion-referenced measures are items designed to test student achievement of the performance objectives. They are test situations which instruct the student to perform a certain action.

The performance guides which accompany most of the objectives and measures are procedural steps identified as subordinate to task performance. They may require slight modification because of equipment differences, availability of tools, and local practice, and are suggested items. Only one performance guide is given per item, although there may be several ways to approach the objective.

Literature sources which were identified during the state-of-the-art study of plumbing training are cited in Appendix C. This literature will be valuable to instructors and instructional materials specialists who wish to develop detailed instructional materials based upon the catalog information.

The cross-reference table presented in Appendix D is designed primarily for use by the V-TECS central office. The stanine values cited in the table, however, can be used as an aid to sequencing instruction by instructional materials developers and plumbing instructors. The higher the stanine value, the more significant are the catalog objectives in terms of time-spent in performance on the job and/or difficulty in performing the task. Detailed explanations regarding the contents of the cross-reference table are provided in Appendix D.

VI. PERFORMANCE OBJECTIVES, CRITERION-REFERENCED MEASURES, AND PERFORMANCE GUIDES

Duty: INTRODUCTION TO PLUMBING

Task: PURPOSE OF PLUMBING

1. Performance Objective

Given adequate reference materials, list and describe the purpose and benefits of plumbing as it exists today, to the satisfaction of the instructor.

Criterion-Referenced Measure

List and describe the purpose and benefits of plumbing.

Performance Guide

1. Gather information.
2. Compile information.
3. List purposes and benefits.
4. Describe purposes and benefits.

Duty: INTRODUCTION TO PLUMBING

Task: PLUMBING SAFETY

---

2. Performance Objective

Given access to information and resources, describe the school and OSHA safety requirements that deal with the plumbing industry.

Criterion-Referenced Measure

Describe the safety requirements that deal with the plumbing industry.

Performance Guide

1. Gather information.
2. Organize information.
3. Describe safety requirements.

Duty: INTRODUCTION TO PLUMBING

Task: ETHICS OF THE PLUMBING INDUSTRY

---

3. Performance Objective

Given a questionable situation, involving a plumber and a customer, determine a proper solution to the satisfaction of the parties concerned. The solution must be satisfactory to the instructor.

Criterion-Referenced Measure

Determine a satisfactory solution to the problem

Performance Guide

1. Analyze problem situation.
2. Determine possible solution(s).
3. Present solutions to concerned parties.
4. Determine most satisfactory solution.

Duty: INTRODUCTION TO PLUMBING

Task: USE OF BASIC PLUMBING TOOLS

---

4. Performance Objective

Given demonstration or referenced materials of each of the basic plumbing tools, identify basic plumbing tools and if applicable, state materials each is used with.

Criterion-Referenced Measure

Identify and, if applicable, describe materials each tool is used with.

1. Pipe cutters
2. Pipe dies
3. Soldering equipment
4. Screw drivers
5. Pliers
6. Wrenches
7. Lead pot
8. Tubing benders
9. Plumb bobs
10. Vices
11. Digging and filling tools

Performance Guide

1. Identify each tool
2. Describe kind of material each is used with.

Duty: INTRODUCTION TO PLUMBING

Task: READING A RULE

---

5. Performance Objective

Given instructional demonstration and materials, demonstrate ability to read a rule accurately.

Criterion-Referenced Measure

Accurately read the measurement of:

1. Various pipe lengths
2. Inside sizes of pipes and fittings

Performance Guide

1. Measure length of pipes set out by instructor.
2. Measure inside diameter of pipes and fittings.

Duty: INTRODUCTION TO PLUMBING

Task: USE OF BASIC MATERIALS AND FITTINGS.

6. Performance Objective

Given demonstrations and or instructional materials, identify basic plumbing materials and fittings.

Criterion-Referenced Measure

Identify correctly:

1. Cements
2. Pipe dopes
3. Solders
4. Galvanized fittings
5. Copper fittings
6. Plastic fittings
7. Cast iron fittings
8. Clay fittings
9. Fillers

Performance Guide

1. Identify and secure items presented by the instructor.

Duty: INTRODUCTION TO PLUMBING

Task: **Demonstrate the use of equipment or tools**

---

7. PERFORMANCE OBJECTIVE:

In a group setting with training aids and equipment provided, demonstrate the proper use and techniques of operating a given tool or piece of equipment. Each participant in the group should then operate correctly in a practice session the tool or piece of equipment as observed by the instructor. (1)

CRITERION-REFERENCED MEASURE:

During a training session, demonstrate the use of a given tool or piece of equipment.

PERFORMANCE GUIDE:

1. Outline uses.
2. Emphasize important features.
3. Emphasize safety measures.
4. Demonstrate storage and handling.
5. Demonstrate actual use.
6. Review steps 1 through 4.
7. Repeat step 5.

Duty: INTRODUCTION TO PLUMBING

Task: PURPOSE OF PLUMBING CODES

8. Performance Objective

Given adequate reference materials, list and describe the reasons why a plumbing code is required. The reasons must include those on the instructor's check list.

Criterion-Referenced Measure

List and describe the major reasons for having a plumbing code.

Performance Guide

1. Gather information.
2. Identify major reasons for codes.
3. List major reasons for codes.
4. Describe major reason for codes.

Duty: INTRODUCTION TO PLUMBING

Task: USES OF PLUMBING CODES AND LOCAL AMENDMENTS

---

9. Performance Objective

Given a set of job specifications and the plumbing code with local amendments, identify and locate the applicable sections of the code. Sections identified and located must agree with those determined by the instructor.

Criterion-Referenced-Measure

Identify and locate the applicable section(s) of the plumbing codes and local amendments for the job specified.

Performance Guide

1. Identify job to be done.
2. Locate applicable section(s) in the latest edition of the SBCC Plumbing Code.
3. Locate applicable section(s) in the local amendments, if any.
4. Have instructor check your work.

Duty: BLUEPRINT READING

Task: Identify symbols for plumbing fittings and fixtures

---

10. Performance Objective

Given a set of blueprints and a legend of plumbing symbols, correctly identify all plumbing symbols for fittings and fixtures.

Criterion-Referenced Measure

Correctly identify all plumbing fittings and and fixtures on blueprint provided by the instructor.

Performance Guide

1. Study legend of symbols.
2. Identify fittings and fixtures.
3. List fittings and fixtures.

Duty: BLUEPRINT READING

Task: Sketch floor plan

---

11. Performance Guide

On a given floor plan, including a kitchen and bath, show the location of all fixtures using correct symbols. Completed work will be evaluated using the checklist.

Criterion-Referenced Measure

On a given floor plan, sketch plumbing fixtures using the correct symbols.

Performance Guide

1. List and locate required fixtures on given plan.
2. Use proper symbols to indicate location of fixture.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Fixtures properly located.	☐
2.	Proper symbols used.	☐
3.	Minimum Fixture used.	☐
4.		☐
5.		☐
6.		☐
7.		☐
8.		☐

Duty: BLUEPRINT READING

Task: Diagram drainage system.

---

12. Performance Objective

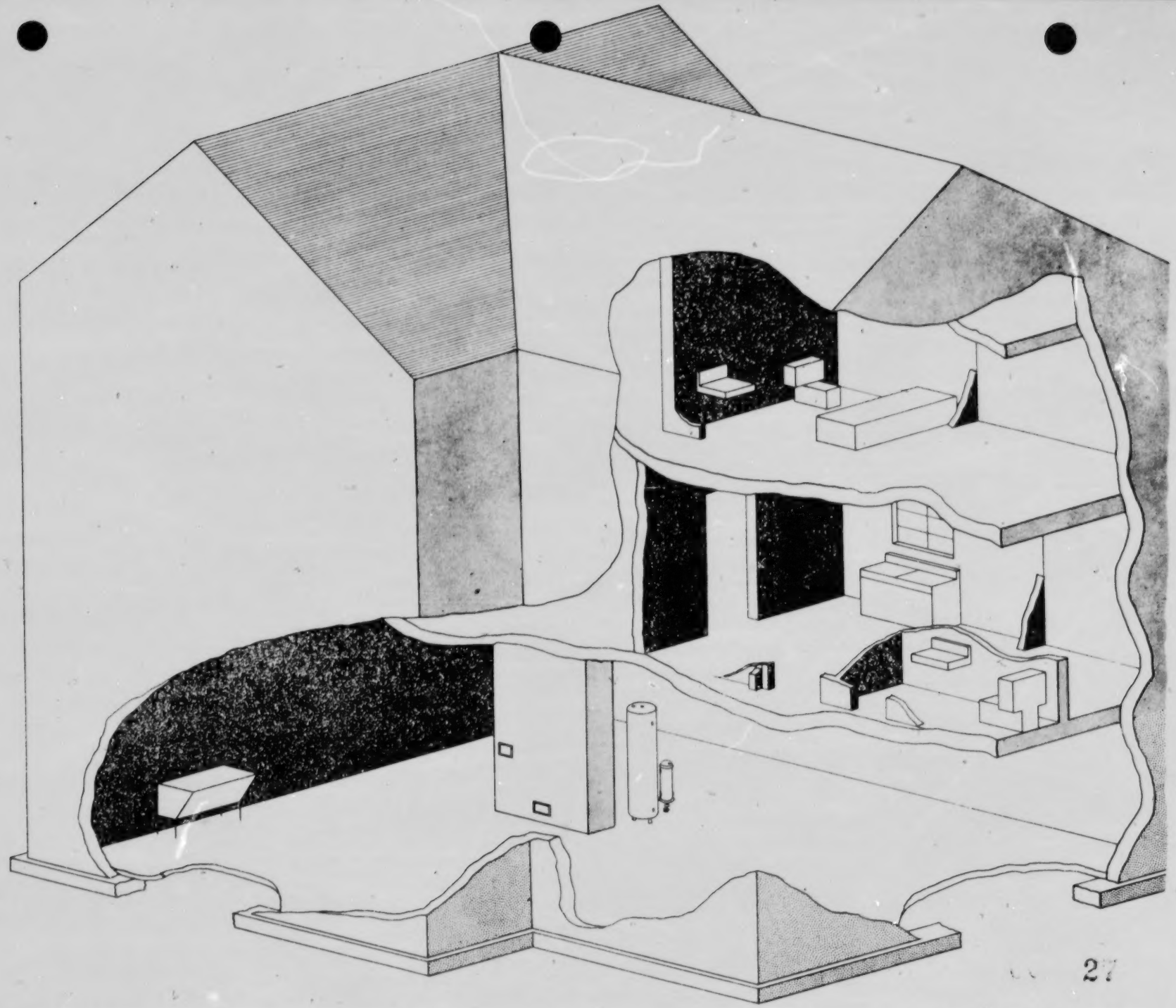
Given an oblique drawing, diagram a drainage system to the satisfaction of the instructor. The system must conform to all existing plumbing codes.

Criterion-Referenced Measure

Diagram a drainage system on the oblique drawing provided.

Performance Guide

1. Determine point of discharge.
2. Properly size all pipes as drawn.
3. Use solid line for drainage, broken line for venting.
4. Show location and size of all required clean outs.



Duty: BLUEPRINT READING

Task: Diagram hot and cold water systems.

---

13. Performance Objective

Given an oblique drawing, diagram a hot and cold water system to the satisfaction of the instructor. The systems must conform to all existing codes.

Criterion-Referenced Measure

Diagram a hot and cold water system on the oblique drawing provided.

Performance Guide

1. Determine point of entry.
2. Properly size all pipes as drawn.
3. Identify hot and cold lines with colored ink - Red for hot - Black for cold.

Duty: PREPARATION AND JOINING OF PIPES

Task: **Bend copper tubing with spring bender**

---

14. PERFORMANCE OBJECTIVE:

Given a 1/2"spring bender, a 3' section of 1/2" diameter soft copper tubing, and a flat working surface, bend the copper tubing to an angle of 90°. A tolerance of ± 3° will be allowed for the bend angle. No crimps should appear in the completed bend. Completed work will be evaluated using the check sheet. (1)

CRITERION-REFERENCED MEASURE:

Bend 1/2" diameter soft copper tubing to an angle of 90°.

PERFORMANCE GUIDE:

1. Insert tubing into bender.
2. Clasp spring enclosed tubing with both hands–thumbs pointing inward one inch apart.
3. Form bend with thumbs and hand pressure.
4. Check bend angle.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe bent to 90° angle ($\pm$ 3°). ☐
2. Bend properly positioned. ☐
3. Pipe not damaged during bend. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Cut cast-iron soil pipe with snap-type chain cutter

---

15. PERFORMANCE OBJECTIVE:

Using a snap-type chain cutter, cut 3" from a 3' length of 4" diameter cast-iron pipe. The tolerance in the length will be 1/4", and the cut ends must be free of flakes. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

A section of 4" diameter cast-iron soil pipe and a snap chain cutter have been provided for use. Cut a 3" length from this pipe, using a flat surface as a work base.

PERFORMANCE GUIDE:

1. Measure and mark length to be cut.
2. Stretch chain on cutter and wrap it securely around pipe at point marked previously.
3. Lock chain cutter in place.
4. Briskly depress cutter handles until pipe falls apart.
5. Chip flakes from cut ends with a hammer. This is necessary when using gasket joints.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Pipe cut to correct length	☐
2.	Pipe not broken on end.	☐
3.	Pipe cut even (square) on end.	☐
4.		☐
5.		☐
6.		☐
7.		☐
8.		☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Cut copper tubing and pipe with hacksaw

16. PERFORMANCE OBJECTIVE:

Given a 6′ folding rule, a 2′ length of 3/8″ diameter copper tubing, holding device, hacksaw and reamer, measure and cut 6″ from a length of copper tubing. A tolerance of ± 1/8″ will be allowed for the cut piece. All burrs must be removed from cut ends. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Cut 6″ from a length of copper tubing using the tools provided by your instructor.

PERFORMANCE GUIDE:

1. Measure and mark piece to be cut from tubing.
2. Secure tubing in holding device.
3. Center cutting edge of hacksaw on mark. Move hacksaw blade back and forth slowly on mark to begin cut.
4. Cut tubing with back and forth sawing action.
5. Ream cut ends.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe cut to proper length (± 1/16").
2. Pipe properly reamed.
3. Pipe end not distorted or flattened.
4.
5.
6.
7.
8.

Duty: PREPARATION AND JOINING OF PIPES

Task: **Cut copper tubing and pipe with tubing cutter**

---

17. PERFORMANCE OBJECTIVE:

Using a tubing cutter, cut 2" from a 1' section of 1/2" diameter copper tubing. The tolerance of the length of cut will be 1/16", and the cut tubing end must be free of burrs and not flattened. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

A tubing cutter and a 1' section of 1/2" diameter copper tubing have been provided for you. Cut 2" from the tubing.

PERFORMANCE GUIDE:

1. Measure and mark tubing length to be cut.
2. Place tubing cutting wheel on mark where tubing is to be cut. Slowly tighten roller against tubing.
3. Rotate cutter around circumference of tubing.
4. Tighten cutting wheel and repeat step 3 as often as needed to complete cut.
5. Ream cut end to remove burrs.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. All burrs removed. ☐
2. Cut pipe to proper length (± 1/8") ☐
3. Pipe properly reamed ☐
4. Work neatly done. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Cut steel pipe with 4-wheel pipe cutter

18. PERFORMANCE OBJECTIVE:

Given a 6' folding rule, four-wheel steel pipe cutter, plumbing tools, and a length of 2 1/2" diameter steel pipe located in a trench 16" wide and 20" deep, cut 6" from the steel pipe. A tolerance of ± 1/8" will be allowed for the cut piece, and the cut ends must be free of burrs. Completed work will be evaluated using the checklist.
(1)

CRITERION-REFERENCED MEASURE:

Cut 6" from a length of pipe positioned in a trench 16" wide and 20" deep.

PERFORMANCE GUIDE:

1. Position pipe for cutting.
2. Measure and mark length of pipe to be cut.
3. Place pipe cutting wheels on mark to be cut.
4. Tighten cutting wheels on pipe.
5. Rotate cutter 1/4 revolution; stop, reverse 1/4 revolution and tighten cutting wheels. Continue this sequence until cut is complete.
6. Ream inside of pipe.
7. Remove exterior burrs with file.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe cut in ditch. ☐
2. Pipe cutter properly used, ☐
3. Pipe cut to proper length ($\pm$ 1/8"). ☐
4. Cut end of pipe free of burrs. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Cut steel pipe with one-wheel cutter**

---

19. PERFORMANCE OBJECTIVE:

Given a one-wheel steel pipe cutter and a vise, cut 3" from a 2' length of 3/4" diameter steel pipe. A tolerance of ± 1/16" will be allowed for the cut piece, and the cut ends must be free of burrs. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

A one-wheel steel pipe cutter and vise have been provided for you. Cut 3" from a 2' length of 3/4" diameter steel pipe.

PERFORMANCE GUIDE:

1. Secure pipe in vise, leaving approximately 6" of the end to be cut protruding from the vise.
2. Measure and mark length to be cut.
3. Place pipe cutting wheel on mark to be cut.
4. Tighten cutting wheel on pipe.
5. Make one complete revolution with pipe cutter.
6. Tighten cutting wheel, making 1/4 turn with adjustment handle or knob.
7. Continue to revolve and tighten cutting wheel until cut is completed.
8. Ream cut ends.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe correctly marked for cutting. ☐
2. Pipe cutter properly tightened. ☐
3. Pipe cut to correct length (± 1/16") ☐
4. Cut end of pipe free of burrs. ☐
5. Cut end of pipe properly reamed. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join cast-iron soil pipe, using lead and oakum

20. PERFORMANCE OBJECTIVE:

Provided two 5′ lengths of 4″ diameter bell and spigot cast-iron soil pipe in a horizontal position, and access to appropriate tools and supplies, join the two sections of soil pipe, using lead and oakum. The joint must be firmly packed with oakum and filled with molten lead not less than 1 inch deep and not to extend more than 1/8 inch below the rim of the hub. The lead must be caulked tight. (2, 4-2)

CRITERION-REFERENCED MEASURE:

Using the materials provided, join cast-iron soil pipe in a horizontal position.

PERFORMANCE GUIDE

1. Safety Glasses required.
2. Light melting furnace and heat lead.
3. Inspect bell and spigot ends to be caulked for moisture. Use dry rag to remove moisture.
4. Place spigot end of pipe into bell of other pipe.
5. Align pipe so that an equal space between pipe and hub is maintained around the circumference of joint.
6. Yarn oakum into hub with a yarning iron; then use packing iron and ball peen hammer to pack oakum tight.
7. Skim slag from molten lead.
8. Clamp joint runner around pipe.
9. Dip ladle full of molten lead from melting pot and pour lead into joint runner.
10. Allow lead to cool and remove joint runner.
11. Remove excess lead with cold chisel.
12. Using an inside caulking iron and ball peen hammer, caulk lead around pipe.
13. Using outside caulking iron and ball peen hammer, caulk lead around inside hub wall. (3)

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Spigot end centered in bell.	☐
2.	Lead and oakum caulked tight.	☐
3.	Lead within 1/8" from rim of hub.	☐
4.		☐
5.		☐
6.		☐
7.		☐
8.		☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Join cast-iron pipe to clay pipe**

---

21. PERFORMANCE OBJECTIVE:

Given a 4" diameter cast-iron drain line 3' long, a 5' section of 6" diameter clay sewer pipe in a trench and appropriate materials, join cast-iron pipe to clay pipe. The joint compound must be beveled smoothly around the hub of the clay pipe. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Your instructor will arrange the needed tools and materials for you. Join a cast-iron soil drain pipe to a section of clay sewer pipe located in a trench.

PERFORMANCE GUIDE:

1. Place appropriate size cast-iron to clay pipe adapter over cast-iron spigot end.
2. Place hub of clay pipe over adapter.
3. Align pipe so that an equal clearance is maintained around circumference of joint.
4. Yarn oakum around joint, leaving a 1" cavity for wiping compound.
5. Fill remaining cavity of joint with wiping compound, rolling about 1" of additional joint compound needed for completing joint.
6. Bevel compound smoothly around hub of clay pipe.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipes measured for correct length. ☐
2. Pipes measured for correct diameter. ☐
3. Joint compound is beveled smooth around hub of clay pipe. ☐
4. Completed job neatly done. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Wipe clay pipe joints

---

22. PERFORMANCE OBJECTIVE:

Given a flat surface, yarning iron, oakum, putty knife and tar compound, wipe a 4" diameter clay pipe joint. Equal clearance between the spigot and the bell must be maintained, and the tar compound must be beveled smoothly along the joint. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Wipe a 4" diameter clay pipe joint with oakum and a tar compound.

PERFORMANCE GUIDE:

1. Position pipes on flat surface.
2. Slide spigot end into pipe bell.
3. Stuff oakum between spigot and bell with yarning iron, maintaining equal clearance between exterior of the spigot and the interior of bell. Leave 3/4" to 1" depth cavity in joint for tar compound application.
4. Fill joint cavity with tar compound–rolling approximately 1" extra material.
5. Bevel and smooth joint with hand or putty knife.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe spigot properly centered in bell. ☐
2. Tar compound beveled smoothly. ☐
3. Joint is all the way up. ☐
4. Oakum is not blocking waste flow. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join clay pipe with couplings.

---

23. PERFORMANCE OBJECTIVE:

Given a joint lubricant, lubricant brush, wiping rag and Dickey-type clay pipe, join two 5′ sections of 6″ diameter clay pipe. The completed joint must bond firmly with no leaks evident. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Join two sections of 6″ diameter clay pipe, using the tools and supplies provided for you.

PERFORMANCE GUIDE:

1. Clean pipe ends with rag.
2. Apply joint lubricant inside pipe coupling and outside bald end of pipe to be joined.
3. Place pipe coupling against bald end of pipe to be joined and press two ends together.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe ends properly cleaned. ☐
2. Joints properly lubricated. ☐
3. Pipe spigot inserted to full depth of hub. ☐
4. Joint does not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join copper tubing to brass pipe

---

24. PERFORMANCE OBJECTIVE:

Given appropriate pipe adapter, plumbing tools and materials, and a situation requiring fitting copper tubing to brass tubing, join 3/4" diameter copper tubing to a 3/4" diameter threaded brass pipe. The finished work will be inspected by the instructor using a leak test. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Check with the instructor, who will arrange for you to join 3/4" diameter copper tubing to a 3/4" diameter brass pipe.

PERFORMANCE GUIDE:

1. Cut copper tubing to length. Ream cut end to be joined.
2. Slide copper tubing into adapter.
3. Solder joints, holding tubing with pliers while soldering and until cool
4. Screw threaded end of brass pipe into adapter fitting and tighten.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipes properly prepared and cleaned. ☐
2. Flux paste and pipe compound correctly applied. ☐
3. Joint shows complete solder penetration. ☐
4. Pipe threaded to correct depth. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Join copper tubing/pipe to copper pipe/tubing**

---

25. PERFORMANCE OBJECTIVE:

Given access to tools, equipment and supplies, join two short lengths of 3/4" diameter rigid copper tubing. The joint must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the storage area and retrieve two short lengths of 3/4" diameter rigid copper tubing. Join two ends together with a sweat fitting using the necessary tools, equipment and supplies from the tool room.

PERFORMANCE GUIDE:

1. Ream and clean ends to be soldered.
2. Apply flux or paste to outside of tubing and inside of coupling.
3. Slide tubing ends into coupling and support assembly.
4. Apply heat evenly around fitting with oxyacetylene torch. When flux or paste bubbles out around joint, remove torch flame.
5. Apply solder to joints around fitting ends. When a line of solder shows completely around joint, connection is filled with solder.
6. Clean flux or paste and solder residue from joint.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tubing inserted into fitting the correct distance. ☐
2. Flux and solder residue removed and joint is clean. ☐
3. Correct amount of solder used. i.e. no runs or lumps of solder around joint. ☐
4. Joint does not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join copper tubing/pipe to plastic pipe

---

26. PERFORMANCE OBJECTIVE:

Given a 1' length of available 1" copper tubing, a 1' length of 1" diameter plastic pipe, a copper-plastic adapter and appropriate tools and materials, join the sections, forming a watertight seal. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Join a length of 1" diameter copper tubing to a length of 1" diameter plastic pipe. You will be provided needed materials.

PERFORMANCE GUIDE:

1. Position plastic pipe on a raised flat surface and cut to square with hacksaw.
2. Ream plastic pipe end, inside and out, with knife.
3. Clean exterior pipe end (1 1/2" to 2") and inside of female adapter with cleaner.
4. Apply cement to cleaned pipe end.
5. Insert plastic pipe into adapter firmly against shoulder.
6. Twist pipe 1/2 turn and allow to dry.
7. Square copper tubing end with tubing cutter and ream with reamer.
8. Slide flare nut on tubing and flared tubing end.
9. Position flared tubing end to adapter and tighten flare nut to adapter.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. All pipe end cut square and reamed. ☐
2. Plastic joint properly made. ☐
3. Copper pipe properly flared i.e. smooth, no burrs. ☐
4. Joint does not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join copper tubing/pipe to plastic pipe, using sweat method

---

27. PERFORMANCE OBJECTIVE:

Given two 1' lengths of 1 1/2" diameter pipe (one plastic and one copper), join the two together, using a sweat adapter to form a watertight seal as evidenced by a leak test. Appropriate tools and materials will be supplied. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Join a length of copper pipe to plastic pipe by the sweat method, using materials that have been provided for you.

PERFORMANCE GUIDE:

1. Clean copper pipe end and female adapter with emery cloth.
2. Apply flux or paste to copper pipe end and female adapter.
3. Insert copper pipe into adapter and twist slightly.
4. Light torch, adjust to blue flame and heat areas of copper overlap until flux or paste bubbles.
5. Apply solder and allow to cool. Remove excess solder with cloth.
6. Clean plastic pipe end and plastic section of female adapter with cleaner. Allow to dry.
7. Apply cement to plastic pipe end and inside of adapter.
8. Insert cemented pipe end into female adapter and butt firmly against adapter shoulder.
9. Twist cemented joint 1/2 turn and allow to dry.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Copper joint properly prepared. ☐
2. Excess flux and solder removed from joint. ☐
3. Plastic pipe properly prepared. ☐
4. Joint does not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join copper tubing to steel pipe

28. PERFORMANCE OBJECTIVE:

Given a 3′ length of 1″ diameter copper tubing, a 1″ diameter threaded steel pipe 2′ long, a dielectric fitting and the proper tools and materials, join the length of tubing to the pipe length, using the sweat method. When subjected to a pressure test, no leaks should appear at the joint. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Join a length of copper tubing to a length of steel pipe, using a dielectric fitting. Materials will be provided for you.

PERFORMANCE GUIDE:

1. Check copper tubing for square and burrs; cut and ream if necessary.
2. Disassemble dielectric fitting.
3. Clean copper tubing end and inside of female section of copper fitting with emery cloth.
4. Apply flux to cleaned areas of tubing and fitting.
5. Insert tubing end into female section of fitting and twist slightly. Tube end should rest firmly against shoulder of female section.
6. Light torch, adjust to blue flame and heat areas of copper overlap until flux bubbles.
7. Apply solder and allow to cool. Remove excess solder and flux with cloth.
8. Apply pipe sealant to male pipe threads.
9. Attach threaded section of fitting to the pipe and tighten.
10. Reassemble fitting ends together, using wrenches in such a manner that stress on copper solder joint is avoided.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Copper tubing cut square and reamed.	☐
2.	Copper tubing joint properly prepared and soldered.	☐
3.	Excess solder and flux removed.	☐
4.	Pipe joint properly prepared-i.e. threads cleaned and sealant applied.	☐
5.	Pipe tightened correctly - i.e. not over tightened to expand or split fitting.	☐
6.	Joint does not leak.	☐
7.		☐
8.		☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join copper tubing with compressed connectors

29. PERFORMANCE OBJECTIVE:

Equipped with the proper tools, two 1' sections of 1/4" diameter copper tubing and a compression union, join the tubing together using the union. The joint should not leak when pressure is applied. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Connect two sections of copper tubing by means of a compression union.

PERFORMANCE GUIDE:

1. Square tubing ends and remove burrs, if needed.
2. Insert nut and ferrule onto end of tubing.
3. Insert tubing end into female center portion of union.
4. Position nut and ferrule and tighten with wrenches–ferrule is compressed, forming seal.
5. Repeat steps 2, 3 and 4 for remaining side.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tubing ends square, reamed and burrs removed. ☐
2. Nuts and ferrules correctly put on tubing. ☐
3. Joint tightened properly - i.e. tubing not distorted or twisted. ☐
4. Joint does not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join copper pipe using flare connectors

29a. PERFORMANCE OBJECTIVE:

Given the proper tools, two 1' sections of 1/4" diameter copper tubing and a flare union, join the tubing together using the union. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Connect copper tubing with flare connectors.

PERFORMANCE GUIDE:

1. Square tubing ends, ream and remove burrs.
2. Place flare nuts over tubing ends
3. Flare tubing.
4. Tighten flare nuts on union using correct size wrenches.
5. Use caution so tubing is not distorted or twisted when tightening flare nuts.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Tubing ends squared, reamed and burrs removed.	☐
2.	Flare nuts put on tubing before flaring.	☐
3.	Flare is smooth and even.	☐
4.	Joint does not leak.	☐
5.		☐
6.		☐
7.		☐
8.		☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Join pipe with no-hub or band clamp couplings**

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30. PERFORMANCE OBJECTIVE:

Given a plumber's tool kit, hubless cast-iron soil pipe, and a pipe support, join two 3′ lengths of 4″ diameter cast-iron soil pipe with no-hub type couplings. The pipe joint must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Using no-hub type couplings, join 4″ diameter hubless cast-iron soil pipe.

PERFORMANCE GUIDE:

1. Cut pipe ends to square, if necessary.
2. Insert pipe ends into gasket, firmly seated against center shoulder rib.
3. Secure pipe in place.
4. Position stainless steel shroud to surround and cover gasket.
5. Position band clamps.
6. Torque bands to 60 pounds. (5: 98-101)

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe firmly seated against center shoulder rib. ☐
2. Stainless Steel shroud surrounds and covers gasket. ☐
3. Clamps properly positioned and torqued to 60 pounds. ☐
4. Joint does not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join plastic pipe to cast-iron pipe with no-hub couplings

31. PERFORMANCE OBJECTIVE:

Given two 3′ sections of 3″ diameter pipe (one plastic and one cast-iron), a no-hub coupling and proper tools, join the sections of pipe together so that a watertight seal is formed as evidenced by a leak test. Completed work will be evaluated using the checklist (1)

CRITERION-REFERENCED MEASURE:

Join two lengths of pipe, one plastic and one cast-iron. A coupling and tools will be provided for you.

PERFORMANCE GUIDE:

1. Cut pipe ends to square, if necessary.
2. Align pipe ends several inches apart.
3. Insert pipe ends to center rib of no-hub gasket.
4. Position and adjust stainless steel shroud to surround and cover gasket.
5. Position clamps on both sides of rib and tighten to desired torque.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe ends cut square. ☐
2. Pipe properly inserted to center rib of no-hub gasket. ☐
3. Stainless steel shroud properly positioned to surround and cover gasket. ☐
4. Position clamps and tighten to proper torque. ☐
5. Joint does not leak. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Join plastic pipe, using solvent cement method**

---

32. PERFORMANCE OBJECTIVE:

Given two 3' sections of 2" diameter PVC pipe, an appropriate adapter, plastic pipecleaner, plastic pipe cement and brush, join the lengths of pipe. The finished joint must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Join two 3' lengths of 2" diameter CPVC, ABS, or PCV pipe, using the adapter-cement method.

PERFORMANCE GUIDE:

1. Check ends of pipe for square and burrs.
2. Clean pipe ends and fitting sockets with cloth, if necessary.
3. Apply pipe cleaner to outside male end of pipe and inside socket fitting.
4. Apply cement to male end of pipe and inside socket of fitting with brush.
5. Insert male end of pipe fully into socket while cement is still wet. Rotate pipe 1/2 turn.
6. Repeat steps 3-5 for remaining end of fitting and second length of pipe.
7. Wipe off excess cement after joining each end.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe ends squared and burrs removed. ☐
2. Pipe ends and fitting cleaned. ☐
3. Cement applied to pipe and fitting. ☐
4. Pipe inserted completely and properly into fitting. ☐
5. Excess cement cleaned from joint. ☐
6. Joint does not leak. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join plastic pipe to steel pipe

33. PERFORMANCE OBJECTIVE:

Given a 2′ length of 1″ diameter plastic pipe, a 2′ length of 1″ diameter steel pipe with threads, a female adapter and the necessary tools and materials, join the sections of pipe together so that a watertight seal is formed as evidenced by a leak test. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Join a section of plastic pipe to a section of steel pipe, using a plastic-steel adapter and tools provided for you.

PERFORMANCE GUIDE:

1. Apply pipe sealant to male threads of steel pipe.
2. Attach female plastic adapter to steel pipe and tighten with wrench.
3. Clean inside of adapter and plastic pipe end with cleaner and allow to dry.
4. Apply plastic cement to inside of adapter and to outside of plastic pipe end.
5. Insert plastic pipe end into adapter; pipe end should butt firmly against adapter shoulder.
6. Twist plastic pipe 1/2 turn and allow to dry for several minutes.
7. Remove excess cement.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Threaded joint tightened properly. ☐
2. Plastic pipe and fitting properly cleaned. ☐
3. Plastic pipe inserted into adapter correct distance. ☐
4. Excess plastic cement and pipe dope removed from joint. ☐
5. Joint does not leak. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Join steel pipe to cast-iron pipe with no-hub couplings

---

34. PERFORMANCE OBJECTIVE:

Given two 3' sections of 3" diameter pipe (one steel and one cast-iron) an appropriate size stainless steel no-hub coupling and the proper tools, join the two sections together so that the joint is watertight as evidenced by a leak test. Completed work will be evaluated using checklist. (1)

CRITERION-REFERENCED MEASURE:

Join a section of steel pipe to a section of cast-iron pipe, using a no-hub coupling.

PERFORMANCE GUIDE:

1. Align pipe ends several inches apart.
2. Insert pipe ends to center rib of no-hub gasket.
3. Position stainless steel shroud to cover gasket.
4. Locate and tighten band clamps with torque wrench to desired torque.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe ends cut square. ☐
2. Pipe end fit snugly against center rib of gasket. ☐
3. Stainless steel shroud fitted properly. ☐
4. Stainless steel band torqued properly. ☐
5. Joint is leak proof. ☐
6. ☐
7. ☐
8. ☐

Duty: **PREPARATION AND JOINING OF PIPES**

Task: **Thread steel pipe with adjustable die**

---

35. PERFORMANCE OBJECTIVE:

Using an adjustable die and a table vise, cut threads on one end of a 1" diameter steel pipe 3' in length. The completed threads must be free of nicks and burrs. Completed work will be evaluated using checklist. (1)

CRITERION-REFERENCED MEASURE:

Thread one end of a 1" diameter steel pipe. Use an adjustable die, table vise and working materials supplied for you.

PERFORMANCE GUIDE:

1. Secure pipe in vise.
2. Place round guide end of pipe die stock on pipe end to be threaded.
3. Press dies against pipe end with heel of hand. Hold hand against dies while taking short, clockwise strokes to begin thread-cutting operation.
4. Continue cutting threads until appropriate number of threads project from outside edge of dies. Keep die stock oiled during threading process.
5. Reverse threader and remove dies from threaded end of pipe.
6. Ream out bead in pipe end.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe reamed properly. ☐
2. Pipe beveled properly. ☐
3. Threads are not nicked. ☐
4. Thread length correct. ☐
5. Die properly adjusted. ☐
6. Threads are clean. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Thread steel pipe with non-adjustable die

---

36. PERFORMANCE OBJECTIVE:

Given a ratchet-type, non-adjustable pipe die stock, stand-type vise and pipe threading dies to fit the pipe stock, cut threads on one end of a 1" diameter steel pipe 3' in length. The completed threads must be free of nicks and burrs. Completed work will be evaluated using checklist. (1)

CRITERION-REFERENCED MEASURE:

A stand-type pipe vise and 1" diameter pipe are positioned for you. Cut threads on one end of the pipe, using a hand-operated pipe die stock and dies.

PERFORMANCE GUIDE:

1. Secure pipe in vise.
2. Place round guide end of pipe die stock on pipe and push pipe threading dies against pipe with heel of hand.
3. Exert pressure with heel of hand against pipe die stock and make several short turns in a clockwise direction to start threading action.
4. Turn handle of pipe die stock with even and steady pressure until two newly cut threads project beyond head of die. Oil pipe threading dies after every two or three downward strokes.
5. Reverse ratchet on pipe die stock. Make several short motions backward and forward with die stock to loosen burrs inside dies.
6. Turn pipe dies stock counterclockwise until pipe threading dies are free of threads. (6: 95-96)

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe properly deburred. ☐
2. Pipe properly beveled. ☐
3. Thread length correct. ☐
4. Threads not chipped. ☐
5. Threads are clean. ☐
6. ☐
7. ☐
8. ☐

Duty: **PREPARATION AND JOINING OF PIPES**

Task: **Thread steel pipe with power-driven vise stand**

37. PERFORMANCE OBJECTIVE:

Using a portable power-driven vise stand, cut, thread and ream one end of a 2" diameter steel pipe. The completed threads must be free of nicks and burrs. Completed work will be evaluated using the checklist.

CRITERION-REFERENCED MEASURE:

A portable power-driven vise stand and 2" diameter steel pipe stock have been prepared for you. Cut, thread, and ream one end of the pipe.

PERFORMANCE GUIDE:

1. Insert pipe into chuck and tighten.
2. Place cutter on pipe and allow handle of cutter to rest against either one or both bars as required.
3. Start machine and control cutting action of cutter through handle.
4. Ream pipe in similar manner.
5. Stop machine. Start 2 or 3 threads on pipe by hand with ratchet-type dies.
6. Start machine and cut required number of threads, keeping oil on die stock until appropriate threads are cut.
7. Stop machine, push bars back, and remove dies from pipe by hand. (6:98)

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe cut and reamed properly. ☐
2. Thread length correct. ☐
3. Threads free of nicks and burrs. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Secure with hangers horizontal and vertical lines of pipe to masonry surfaces**

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38. PERFORMANCE OBJECTIVE:

Given an assortment of hangers, necessary tools and equipment, and lengths of pipe of different kinds and sizes, hang one pipe horizontally and one vertically to a masonry surface. The correct hanger must be chosen for the selected pipe. Work will be gauged by a checklist, with all items to be rated yes for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Secure with hangers horizontal and vertical lines of pipe to masonry surfaces, using the materials furnished.

PERFORMANCE GUIDE:

1. Select pipe, position, and needed hanger.
2. Locate hanger points on surface.
3. Prepare surface (if needed).
4. Secure hanger or hanger section (which ever needed) to surface.
5. Attach hanger clamp portion to pipe (if needed).
6. Hoist pipe into position for hanger acceptance.
7. Secure pipe to hanger.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Were hangers properly selected for each pipe and working surface? ☐
2. Were hangers affixed correctly? ☐
3. Are vertical pipes secured at 90° to the floor surface? ☐
4. Are overhead pipes at proper angle to the floor surface? ☐
5. Are distances between hangers correct for pipe used? ☐
6. Is the pipe or tubing secure? ☐
7. Is work neatly done? ☐
8. Does installation comply with local codes? ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: **Secure with hangers horizontal and vertical lines of pipe to metal surfaces**

39. PERFORMANCE OBJECTIVE:

Given an assortment of hangers, necessary tools and equipment, and lengths of pipe of different kinds and sizes, hang one pipe horizontally and one vertically to a metal surface. The correct hanger must be chosen for the selected pipe. Work will be gauged by a checklist, with all items to be rated "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Secure with hangers horizontal and vertical lines of pipe to metal surfaces, using the materials provided.

PERFORMANCE GUIDE:

1. Select pipe, position, and needed hanger.
2. Locate hanger points on surface.
3. Prepare surface (if needed).
4. Secure hanger or hanger section (whichever needed) to surface.
5. Attach hanger clamp portion to pipe (if needed).
6. Hoist pipe into position for hanger acceptance.
7. Secure pipe to hanger.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Were hangers properly selected for each pipe and working surface? ☐
2. Were hangers affixed correctly? ☐
3. Are vertical pipes secured at 90° to the floor surface? ☐
4. Are overhead pipes at proper angle to the floor surface? ☐
5. Are distances between hangers correct for pipe used? ☐
6. Is the pipe or tubing secure? ☐
7. Is work neatly done? ☐
8. Does installation comply with local codes? ☐

Duty: PREPARATION AND JOINING OF PIPES

Task: Secure with hangers horizontal and vertical lines of pipe to wood surfaces

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40. PERFORMANCE OBJECTIVE:

Given an assortment of hangers, necessary tools and equipment, and lengths of pipe of different kinds and sizes, hang one pipe horizontally and one vertically to a wood surface. The correct hanger must be chosen for the selected pipe. Work will be gauged by a checklist with all items to be rated "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Secure with hangers horizontal and vertical lines of pipe to wood surfaces, using the materials prepared for you.

PERFORMANCE GUIDE:

1. Select pipe, position, and needed hanger.
2. Locate hanger points on surface.
3. Prepare surface (if needed).
4. Secure hanger or hanger section (whichever needed) to surface.
5. Attach hanger clamp portion to pipe (if needed).
6. Hoist pipe into position for hanger acceptance.
7. Secure pipe to hanger.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Were hangers properly selected for each pipe and working surface? ☐
2. Were hangers affixed correctly? ☐
3. Are vertical pipes secured at 90° to the floor surface? ☐
4. Are overhead pipes at proper angle to the floor surface? ☐
5. Are distances between hangers correct for pipe used? ☐
6. Is the pipe or tubing secure? ☐
7. Is work neatly done? ☐
8. Does installation comply with local codes? ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Calculate the slope required for building sewer lines

---

41. Performance Objective

Using a line level and measuring tape, calculate the slope required for constructing a building sewer line. The slope tolerance will be a minimum of 1/8" per foot of pipe. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Calculate the slope required for constructing a building sewer line. Use a line level and tape.

Performance Guide

1. Locate point where building sewer will join main sewer.
2. Pull line from stubbed sewer pipe to main sewer line and establish grade at this point.
3. Establish grade on sewer pipe stubbed out of building. The difference between grades established at main sewer and building sewer is slope required for building sewer line.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Length measurement correct. ☐

2. Slope tolerance within limits 1/8" per foot. ☐

3. ☐

4. ☐

5. ☐

6. ☐

7. ☐

8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Install drain pipe in trenches

---

42. PERFORMANCE OBJECTIVE:

Given access to tools, equipment and supplies, install clay pipe in a trench on a minimum grade of 1/8" per foot. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Dig a trench and install clay pipe in the trench on a grade of 1/8" per foot.

PERFORMANCE GUIDE:

1. Determine length of sewer line.
2. Determine if minimum fall from end to end is 1/8" per foot or more.
3. Establish average grade line from end to end.
4. Layout trench with nylon line and stakes.
5. Dig trench to desired depth, maintaining average grade (minimum 1/8" per foot.)
6. Lay pipe in trench and check each length for minimum grade.
7. Join each section of pipe and clean inside joints of excess cement.
8. Test for leaks.
9. Backfill trench.
10. Observe safety practices pertaining to ditches.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Each pipe length has proper grade 1/8" per foot minimum. ☐
2. Entire drain line has proper grade 1/8" per foot minimum. ☐
3. Drain pipe installed according to local code. ☐
4. All joints properly cemented and cleaned. ☐
5. Drain line does not leak. ☐
6. Trench properly backfilled. ☐
7. ☐
8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Backfill trenches

43. PERFORMANCE OBJECTIVE:

Using a shovel and tamp, backfill a graded drain line. The pipe must not be dislocated or cracked. A 3" overfill of dirt should cover the trench. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Backfill a graded drain line.

PERFORMANCE GUIDE:

1. Carefully place a six-inch layer of loose dirt in trench and tamp in place.
2. Compact backfill under and beside pipe for support.
3. Place six-inch layers of dirt in trench and tamp, until backfill is completed.
4. Overfill trench about 3" for settlement.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Ditch back filled as specified. ☐

2. Correct tools were used to backfill ☐

3. Backfill dirt tamped as specified. ☐

4. Ditch overfilled as specified ☐

5. Solid waste was not packed against pipe during backfilling operation. ☐

6. ☐

7. ☐

8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: **Establish grade lines for installing plumbing**

---

44. PERFORMANCE OBJECTIVE:

Using form work for a concrete slab and construction plans, establish grade lines and partition walls for installing building drain and water supply lines. Grade lines must be in accordance with local codes and partitions correctly located. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Establish grade lines and partition walls for installing building drain and water supply lines prior to pouring a concrete slab.

PERFORMANCE GUIDE:

1. Check form work length and width for square, using a 100' tape.
2. Locate plumbing walls, using a blueprint.
3. Stretch nylon string at points where plumbing will be installed.
4. Review established grade lines with contractor.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Form work checked for length, width and square. ☐

2. Blueprint used to locate plumbing walls ☐

3. Nylon string used to locate plumbing points. ☐

4. Established grade lines reviewed with contractor. ☐

5. ☐

6. ☐

7. ☐

8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Lay out house drains

---

45. PERFORMANCE OBJECTIVE:

Using a scale, straightedge and pencil, lay out drain lines on a building blueprint. The drainage system must conform to plumbing codes. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Construction blueprints have been provided for a new building. Plumbing piping was not included on the plan. Lay out the drain lines for the plumbing.

PERFORMANCE GUIDE:

1. Acquire manufacturer's rough-in specifications.
2. Identify location of fixtures.
3. Determine elevations and location of drain piping.
4. Determine type and size pipe required.
5. Determine type fittings for horizontal and vertical runs.
6. Lay out pipe system on the blueprint, indicating pipe, sizes, elevations, and type fittings.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Used manufacturer's rough in specifications. ☐
2. Fixtures located. ☐
3. Elevation and location of drain piping determined. ☐
4. Correct type and size of piping indicated. ☐
5. Correct symbols used. ☐
6. System designed meets plumbing code. ☐
7. ☐
8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Install cleanouts on drains

---

46. PERFORMANCE OBJECTIVE:

Given a 4" cast-iron cleanout plug, a drain line under construction, blueprint, and access to plumbing tools and supplies, install a wall or floor-type cleanout plug. The cleanout must terminate at an accessible point and open in the direction of the flow of the drainage line or at right angles thereto. Completed work will be evaluated using the checklist. (2, 5-4)

CRITERION-REFERENCED MEASURE:

Install a wall or floor cleanout plug in a drain line.

PERFORMANCE GUIDE:

1. Identify proper location of cleanout plug from construction plans.
2. Determine floor elevation or wall thickness.
3. Cut and install hub of drain pipe to accommodate cleanout placement.
4. Insert gasket in hub of drain pipe.
5. Lubricate inside of rubber gasket and outside of plug pipe.
6. Insert plug into drain hub and gasket.
7. Drive cleanout plug into drain hub and gasket, using a 2" x 4" block and hammer.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Clean out properly located. ☐
2. Clean out located properly in relation to direction of flow. ☐
3. Clean out properly installed ☐
4. Clean out elevation correct. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: **Rough-in waste and vent lines for floor-mounted water closets**

47. PERFORMANCE OBJECTIVE:

Provided manufacturer's rough-in instructions and access to plumbing tools, equipment and supplies, rough-in the waste and vent lines for a floor-mounted water closet. The stubbed-out waste line must be located within 1/2" of the manufacturer's specifications. Joints must not leak. Vents and drain lines must be properly graded and installed according to local codes. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Rough-in the waste and vent lines for a water closet when provided rough-in specifications.

PERFORMANCE GUIDE:

1. Lay out waste and vent lines, using the rough-in specifications.
2. Cut pipe to length, as required during installation.
3. Assemble pipe in place, leaving cleanout and vent openings.
4. Set closet collar around waste, using caulk joint.
5. Locate roof position for vent pipe.
6. Cut or form vent pipe hole.
7. Connect vent pipe section from waste line through roof.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste and vent lines laid out according to rough in specifications ☐

2. Floor flange at proper height in relation to final floor level. ☐

3. Air vent size proper and correctly installed. ☐

4. Roof vent flange correctly installed. ☐

5. ☐

6. ☐

7. ☐

8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: **Rough-in waste lines for wall-mounted urinals**

---

48. PERFORMANCE OBJECTIVE:

Given the rough-in specifications and access to plumbing tools, equipment and supplies, rough-in the waste line for a wall-mounted urinal. Finished work must be approved by the instructor, using a checklist. A "yes" rating on each statement is necessary for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Your instructor will furnish the rough-in specifications. Rough-in the waste line for a wall-mounted urinal.

PERFORMANCE GUIDE:

1. Determine drain line location.
2. Lay out plumbing from main line to fixture.
3. Assemble 2" cast-iron line and combination Y and eighth bend.
4. Set fixture line and connect to main drain.
5. Connect line from eighth bend up through slab level.
6. Connect tapped tee to open at urinal trap level.
7. Connect galvanized pipe out of tapped tee through wall.
8. Connect vent line out of tee to desired location.
9. Install cleanout at Y if urinal mounted on exterior wall.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Drain opening for fixture is within ± 1/2" of requirements. ☐

2. Joints are leakproof. ☐

3. Drain line has a grade of at least 1/4" per foot. ☐

4. Vent is properly installed. ☐

5. Urinal is secure to wall. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: **Rough-in waste lines and vents for bathtubs**

---

49. PERFORMANCE OBJECTIVE:

Using the fixture manufacturer's specifications and needed tools and supplies, rough-in the waste lines and vent for a bathtub. Finished work must be approved by the instructor using a checklist in which all statements must be checked "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Your instructor will furnish rough-in specifications for a bathtub. Rough-in the waste lines and vent for the fixture.

PERFORMANCE GUIDE:

1. Take measurements from rough-in specifications.
2. Lay out waste line from main line or from foundation wall to fixture.
3. Cut pipe to length.
4. Assemble pipe, leaving cleanout and vent openings as necessary.
5. Align and support pipe.
6. Insert foam cup for waste line at tub drain, if installing waste in concrete slab.
7. Run vent line from soil pipe to revent line, or through roof.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste line was vented according to code. ☐

2. Cleanout plugs were properly located. ☐

3. Pipes were properly aligned and supported. ☐

4. Proper pipe materials and fittings were used. ☐

5. Joints did not leak when tested. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Rough-in waste lines for shower baths

50. PERFORMANCE OBJECTIVE:

Given manufacturer's rough-in specifications and access to plumbing tools, equipment and supplies, rough-in the waste and vent lines for a built-up shower bath. The stubbed-out waste opening must be located within ± 1/2" of the manufacturer's specifications. Joints must not leak. Vent and waste lines must be properly graded. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Your instructor will arrange for you to rough-in the waste and vent lines for a built-up shower bath. Rough-in measurements will be provided.

PERFORMANCE GUIDE:

1. Lay out drain and vent lines, using rough-in measurements.
2. Cut pipe to length.
3. Join P-trap and Y fitting.
4. Set P-trap assembly and join to main drain line.
5. Connect vent line from Y to revent.
6. Connect shower drain to P-trap.
7. Cover drain cover to protect from obstructions.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste openings within ± 1/2" of manufacturer's specifications. ☐
2. Pipes properly aligned, graded and supported. ☐
3. All joints properly assembled. ☐
4. Joints do not leak. ☐
5. Drain covered for protection. ☐
6. ☐
7. ☐
8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: **Rough-in waste lines and vents for built-in lavatories**

51. PERFORMANCE OBJECTIVE:

Using the fixture manufacturer's specifications, rough-in the waste line and vent for a lavatory. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications. Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Your instructor or supervisor will furnish rough-in specifications for a lavatory. Rough-in the waste lines and vent for the fixture.

PERFORMANCE GUIDE:

1. Lay out waste line from main line to fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping, using no-hub couplings.
4. Attach 2" x 1 1/4" sanitary tee to assembly end.
5. Join 1 1/4" galvanized pipe, using tapped tee for connection.
6. Align and support pipe.
7. Run vent line from soil pipe to revent line, or through roof.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste line correctly laid out from main line to fixture. ☐
2. No-hub couplings used. ☐
3. Correct size and type of tee and pipe used. ☐
4. Waste line stubbed in within ± 1/2" of manufacturer's specifications. ☐
5. Joint does not leak. ☐
6. All lines installed according to local code. ☐
7. ☐
8. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Rough-in waste lines and vents for washer.

---

52. Performance Objective

Using the fixture manufacturer's specifications, rough-in the waste line, trap and vent for a washer. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications. Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Your instructor or supervisor will furnish rough-in specifications for a washer. Rough-in the waste lines and vent for the fixture.

Performance Guide

1. Lay out waste line from main line to fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping, using no-hub couplings.
4. Attach 2" sanitary tee to assembly end.
5. Join galvanized pipe, using tapped tee for connection.
6. Align and support pipe.
7. Run vent line from soil pipe to revent line, or through roof.
8. Install P trap to code specifications.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste line correctly laid out from mainline to fixture. ☐
2. No-hub couplings used. ☐
3. Proper size and type tee and pipe used. ☐
4. Pipe properly aligned and supported. ☐
5. Stand pipe proper height ☐
6. Piping properly vented. ☐
7. Lines do not leak. ☐
8. Lines installed according to local code. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Rough-in waste lines and vents for kitchen sink

---

53. Performance Objective

Using the fixture manufacturer's specifications, rough-in the waste line and vent for a kitchen sink. The stubbed-out waste line must be within ± 1/2" of the manufacturer's specifications. Joints must not leak. Vent and drain lines must be properly graded and installed according to local codes. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Your instructor or supervisor will furnish rough-in specifications for a kitchen sink. Rough-in the waste lines and vent for the fixture.

Performance Guide

1. Lay out waste line from main line to fixture.
2. Measure and cut piping for rough-in plumbing.
3. Assemble piping, using no-hub couplings.
4. Attach 2" x 1½" sanitary tee to assembly end.
5. Join 1½" galvanized pipe, using tapped tee for connection.
6. Align and support pipe.
7. Run vent line from soil pipe to revent line, or through roof.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Waste line correctly laid out from main line to fixture. ☐
2. No-hub coupling used. ☐
3. Correct size and type of tees and pipe used. ☐
4. Pipe properly supported and aligned. ☐
5. Piping correctly vented. ☐
6. Stubbed out waste line within $\pm$ 1.2" of specification. ☐
7. Joints do not leak. ☐
8. Lines installed according to local code. ☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Installation of grease interceptors in waste lines

---

54. Performance Objective

Given instructional materials and specifications for a grease interceptor with steel inlet and outlet extensions, describe the installation of the interceptor at floor level adjacent to a dishwashing sink. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Describe the installation of a grease interceptor in a waste line.

Performance Guide

1. Describe the positioning of interceptor in desired floor location.
2. Describe proper application of sealant to threads of extensions and sink, and vent crossover pipes.
3. Describe connection of extensions and crossovers.
4. Describe connections of crossovers to sink drain tailpipe and vent pipe, using union adapters and repeating steps 2 and 3.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Interceptor positioning properly described.	☐
2.	Proper application of sealant described correctly.	☐
3.	All extension and crossovers properly described.	☐
4.	Finished description complete in all respects.	☐
5.		☐
6.		☐
7.		☐
8.		☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: Install vent terminals (roof-flashing)

---

55. PERFORMANCE OBJECTIVE:

Given a lead hammer and a cast-iron main vent pipe, install a vent terminal on the vent pipe. The terminal must be watertight. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

A main vent pipe is installed through the top of a pitched roof. Install a foot-type vent terminal on the vent pipe.

PERFORMANCE GUIDE:

1. Select vent terminal to match pitch of roof.
2. Slip vent terminal over vent pipe extending through roof.
3. Depending on type vent terminal, bend terminal top over vent pipe, or beat lead top of terminal into cast-iron vent pipe to seal terminal.
4. Seal flashing with tar compound.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1.	Vent terminal correctly selected to match roof pitch.	☐
2.	Vent terminal correctly sealed according to type used.	☐
3.	Flashing sealed with tar compound.	☐
4.	Terminal is watertight.	☐
5.		☐
6.		☐
7.		☐
8.		☐

Duty: DRAINAGE AND VENTING SYSTEMS

Task: **Make water tests on building drains**

56. PERFORMANCE OBJECTIVE:

Given adjustable test plugs, water hose and water supply, perform a water test on a building drain system. The system should be filled to within 2" of highest stack, and no leaks should appear at plugged openings. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Test a building drain system for leaks.

PERFORMANCE GUIDE:

1. Insert test plugs in each opening, except stack above highest fixture.
2. Connect water hose to water supply line and fill stack above highest fixture to within 2" of top with water.
3. Check all plugs and caps for leaks.
4. Allow water to stand in pipe 24 hours.
5. Check pipe for leaks, observing sand holes in pipe, cracked fittings, and leaks in joints.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. All openings properly plugged. ☐
2. Pipes filled to within 2" of highest vent. ☐
3. Water allowed to stand in pipes for 24 hours. ☐
4. All pipes and joints checked for leaks. ☐
5. All plugs removed after testing was completed. ☐
6. ☐
7. ☐
8. ☐

Duty: WATER SYSTEMS

Task: Determine point of entry of water lines

---

57. Performance Objective

Given a set of blueprints, stakes, string and appropriate tools, locate the point of entry of water service for a given set of plans. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Locate point of entry of water service for a given set of plans.

Performance Guide

1. Select point of entry.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water meter located (if applicable) ☐

2. Point of entry to building properly located. ☐

3. Distance correctly measured for pipe length. ☐

4. Pipe properly sized according to specification. ☐

5. Properly staked for straightness of line. ☐

6. ☐

7. ☐

8. ☐

Duty: WATER SYSTEMS

Task: Size water supply system

58. Performance Objective

Given the plumbing specifications, size the pipe for the water and plumbing system. Load valves for all fixtures must be considered. Pipe size must agree with those determined by the instructor. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Determine the pipe for the specified water system.

Performance Guide

1. Determine minimum size pipe for each fixture.
2. Calculate maximum load of water required at any given time.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Minimum size pipe for each fixture determined. ☐
2. Maximum required load of water calculated. ☐
3. Pipe size agrees with specifications. ☐
4. Proper type of pipe used. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: WATER SYSTEMS

Task: Install cut-off valve in stop-and waste-box

---

59. Performance Objective

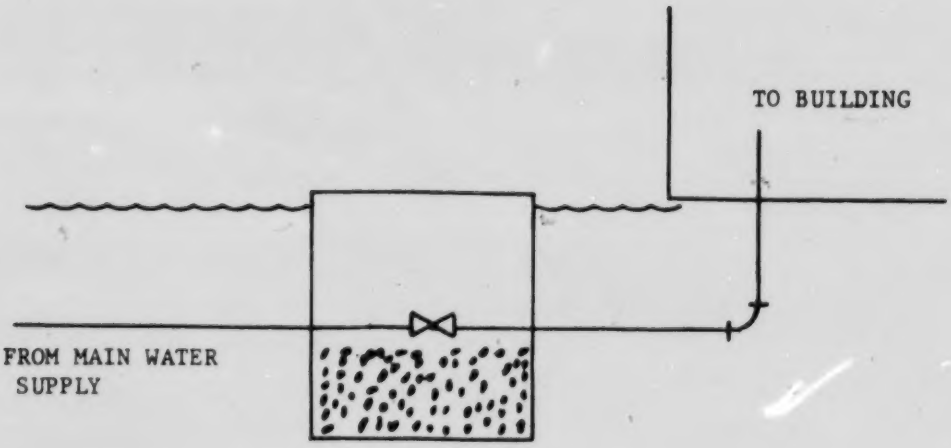
Given a 1" diameter water supply line leading from a main line to a building and access to plumbing tools, equipment and supplies, install a cut-off valve in a stop-and-waste box in the water line. Connections must not leak. **Completed work will be evaluated using the checklist.** (1)

Criterion-Referenced Measure

A 1" diameter water supply line leading from the main line must be connected to the building supply line. Prior to making the connection, install a cut-off valve (gate valve) inside a stop-and-waste box in the water line.

Performance Guide

1. Clean pipe ends befor joining.
2. Connect gate valve to supply pipe, using proper fittings.
3. Dig hole around valve for prefabricated stop-and-waste box.
4. Install prefabricated concrete or cast-iron stop-and-waste box over valve.
5. Place gravel in bottom of box.
6. Place lid on box.



TYPICAL STOP-AND-WASTE CUT-OFF

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pipe ends cleaned before joining. ☐
2. Gate valve connected to supply line with proper fittings. ☐
3. Correct stop and waste box used. ☐
4. Gravel placed in bottom of box. ☐
5. Lid placed on box. ☐
6. Connections did not leak. ☐
7. ☐
8. ☐

Duty: WATER SYSTEMS

Task: **Install check valves on water feed lines**

---

60. PERFORMANCE OBJECTIVE:

Provided with a check valve, a water supply line requiring the valve, and appropriate tools, install a check valve in a water supply line. The valve must be leakproof. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Your instructor will arrange a work situation for you. Install a check valve in a water feed line.

PERFORMANCE GUIDE:

1. Determine direction of water flow in supply line.
2. Identify proper direction of water flow in valve.
3. Measure, cut, and thread pipe for inlet and outlet supply.
4. Assemble components.
5. Connect union in supply line.
6. Connect valve. If it is a swing-type check valve, install with swing pendulum in downward position.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water flow direction in supply line correctly determined. ☐
2. Water flow direction in valve correctly determined. ☐
3. Pipe correctly cut and threaded. ☐
4. Union used in supply line. ☐
5. Pipe correctly joined. ☐
6. If swing valve was used, is pendulum positioned downward? ☐
7. Valve and joints do not lock. ☐
8. ☐

Duty: WATER SYSTEMS

Task: **Rough-in water supply lines for bathtubs**

61. PERFORMANCE OBJECTIVE:

Given a water supply line above or below a bathroom floor level, manufacturer's specifications, and access to plumbing tools, equipment and supplies, rough-in 1/2" diameter copper water supply lines for a shower bath and tub. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

In the situation arranged for you, rough-in 1/2" diameter copper water supply lines for a tub and shower. You may use the fixture manufacturer's rough-in specifications.

PERFORMANCE GUIDE:

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for tub and shower bath to main line tees.
3. Anchor over-rim filler valve in bath wall at proper height and depth.
4. Connect hot and cold water lines to shower-filler valve, with cold water on right facing fixture.
5. Anchor and support tubing as necessary.
6. Solder and anchor shower arm riser.
7. Install shower diverter arm.
8. Cap shower riser and diverter arm lines.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tee soldered on main hot and cold supply lines. ☐
2. Lines for tub and shower correctly connected to main line tees. ☐
3. Over rim filler valve properly installed in bath wall. ☐
4. Cold water valve on right. ☐
5. Tubing anchored and supported as needed. ☐
6. Shower diverter arm installed. ☐
7. All lines capped. ☐
8. Lines located within $\pm$ 1/2" of specifications. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for wall-mounted urinals

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62. PERFORMANCE OBJECTIVE:

Given a previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment and supplies, rough-in a 3/4" or 1" diameter copper water supply line for a wall-mounted urinal. Completed work must be approved by the instructor, using a checklist. All items must be rated "yes" for satisfactory performance. (1, @).

CRITERION-REFERENCED MEASURE:

A work location has been prepared for you. Rough-in a 3/4" or 1" diameter copper water supply line for a wall-mounted urinal.

PERFORMANCE GUIDE:

1. Mark location of water supply line on wall as per specifications.
2. Solder copper tee on main water supply line, if necessary.
3. Connect water supply branch to main supply tee.
4. Run tubing out of wall at correct height from floor.
5. Anchor and support supply line as necessary.
6. Cap end of fixture supply line.
7. Install air chamber, if required.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water supply tubing installed according to rough-in dimensions ± 1/2". ☐
2. Joints are leakproof. ☐
3. Tubing is not in contact with corrosive materials. ☐
4. Tubing is properly anchored. ☐
5. Finished assembly is neat in appearance. ☐
6. Task was finished within established time limit. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for water closets

63. PERFORMANCE OBJECTIVE:

Given a previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment and supplies, rough-in a 1/2", 3/4", or 1" diameter copper water supply line for a water closet. The stubbed-out supply lines must be located within ± 1/2" of the manufacturer's specifications. Joints must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Rough-in a 1/2", 3/4", or 1" diameter copper water supply line for a water closet in a situation that has been prepared for you.

PERFORMANCE GUIDE:

1. Mark location of water supply line on wall. Normally, supply line is roughed-in 6" off center of fixture.
2. Solder tee on main water supply line, if necessary.
3. Connect fixture supply branch to main supply tee.
4. Install air chamber on fixture supply line, if required.
5. Install supply line out of wall at correct height from floor. Normally, tubing should protrude 6" out of wall.
6. Anchor and support supply line as necessary.
7. Cap end of fixture supply line.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water supply line stubbed out 6" above finished floor level. ☐
2. Supply line offset centerline correct distance. ☐
3. Anchor and support pipe as needed. ☐
4. Supply line capped. ☐
5. Joints do not leak. ☐
6. Supply line located with ± 1/2" of specifications ☐
7. ☐
8. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for showers

---

64. Performance Objective

Given a water supply line above or below a bathroom floor level, manufacturer's specifications and access to plumbing tools, equipment and supplies, rough-in 1/2" diameter copper water supply lines for a shower. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

In the situation arranged for you, rough-in 1/2" diameter copper water supply lines for a shower. You may use the fixture manufacturer's rough-in specifications.

Performance Guide

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for shower to main line tees.
3. Connect hot and cold water lines to shower valve with cold water on right facing fixture.
4. Anchor and support tubing as necessary.
5. Solder and anchor shower arm riser.
6. Install shower diverter arm.
7. Cap end of fixture supply lines.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tee correctly soldered on supply lines. ☐
2. Fixture lines properly connected to main line tees. ☐
3. Tubing anchored and supported as needed. ☐
4. Shower arm riser anchored. ☐
5. Shower diverter arm installed ☐
6. All supply lines capped. ☐
7. All stubbed out lines installed within ± 1/2" of spwcifications ☐
8. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for kitchen sink

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65. Performance Objective

Given a water supply line above or below a kitchen floor level, manufacturer's specifications, and access to plumbing tools, equipment and supplies, rough-in 1/2" diameter copper water supply lines for a kitchen sink. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

In the situation arranged for you, rough-in 1/2" diameter copper water supply lines for a kitchen sink. You may use the manufacturer's rough-in specifications.

Performance Guide

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for kitchen sink to main line tees.
3. Anchor over-rim filler valve in kitchen wall at proper height and depth.
4. Connect hot and cold water lines to kitchen sink valve, with cold water on right facing fixture.
5. Anchor and support tubing as necessary.
6. Cap end of supply lines.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tee soldered on supply lines correctly. ☐

2. Kitchen sink lines connected to tees on main lines correctly. ☐

3. Over-rim filler valve properly anchored in kitchen wall. ☐

4. Connect hot and cold lines to sink with cold on right. ☐

5. Tubing anchored and supported as needed. ☐

6. Supply line ends capped. ☐

7. Stubbed out lines within $\pm$ 1/2" of specifications. ☐

8. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for lavatories

66. Performance Objective

Given a water supply line above or below a bathroom floor level, manufacturer's specifications, and access to plumbing tools, equipment and supplies, rough-in 1/2" diameter copper water supply lines for a lavatory. The location stubbed-out lines must be within ± 1/2" of the manufacturer's specifications. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

In the situation arranged for you, rough-in 1/2" diameter copper water supply lines for a lavatory. You may use the fixture manufacturer's rough-in specifications.

Performance Guide

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for lavatory to main line tees.
3. Anchor over-rim filler valve in bath wall at proper height and depth.
4. Connect hot and cold water lines to valve, with cold water on right facing fixture.
5. Anchor and support tubing as necessary.
6. Cap end of supply lines.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tees soldered on main supply lines correctly. ☐
2. Water lines for lavatory connected to main line tees. ☐
3. Over-rim filler valve anchored to wall. ☐
4. Supply lines fastened to valves with cold on right. ☐
5. Supply line ends capped. ☐
6. All lines installed within $\pm$ 1/2 " of specifications. ☐
7. ☐
8. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for washer

67. Performance Objective

Given a water supply line above or below floor level, manufacturer's specifications, and access to plumbing tools, equipment and supplies, rough in 1/2" diameter copper water supply lines for a washer. The location of stubbed-out lines must be within ± 1/2" of the manufacturer's specifications. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

In the situation arranged for you, rough-in 1/2" diameter copper water supply lines for a washer. You may use the fixture manufacturer's rough-in specifications.

Performance Guide

1. Solder tee on main hot and cold water lines.
2. Connect hot and cold water lines for washer to main tee lines.
3. Anchor over-rim filler valve in wall at proper height and depth.
4. Connect hot and cold water lines to washer valve, with cold water on right.
5. Anchor and support tubing as necessary.
6. Cap ends of supply lines.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tees soldered on main supply lines. ☐
2. Washer supply lines connected to main tee lines. ☐
3. Over-rim filler valve anchored to wall. ☐
4. Washer supply lines connected to washer valve with cold on right. ☐
5. Tubing supported and anchored as needed. ☐
6. Supply lines ends capped. ☐
7. All lines installed within $\pm$ 1/2" of specifications ☐
8. ☐

Duty: WATER SYSTEMS

Task: Rough-in water supply lines for water heaters

---

68. PERFORMANCE OBJECTIVE:

Given a previously installed cold water line above or below the floor level, fixture manufacturer's rough-in specifications, and access to plumbing tools, equipment and supplies, rough-in a 3/4" diameter copper water supply line for a hot water heater. The stubbed-out supply line must be located within ± 1/2" of the manufacturer's specifications. Joints must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Rough-in a 3/4" diameter copper water supply line for a hot water heater.

PERFORMANCE GUIDE:

1. Mark location of water supply line on wall.
2. Solder tee on main supply line, if necessary.
3. Connect fixture supply branch to main supply tee.
4. Install supply line out of wall at correct height. Normally, tubing must protrude 6" out of wall.
5. Anchor and support supply line as necessary.
6. Cap end of fixture supply line.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Location of water supply line correctly marked. ☐
2. Tee soldered on main supply line. ☐
3. Fixture supply branch properly connected to main supply tee. ☐
4. Supply line installed out of wall at correct height, should protrude about 6". ☐
5. Supply line anchored and supported as needed. ☐
6. Supply line end capped. ☐
7. Joints do not leak. ☐
8. Line installed within $\pm$ 1/2" of specifications. ☐

Duty: WATER SYSTEMS

Task: **Make water pressure tests on water supply systems**

---

69. PERFORMANCE OBJECTIVE:

Furnished the necessary tools, equipment, materials and a hydrostatic pump, test the water supply lines in a building for leaks. Test make-ups should resemble the accompanying diagram. Work will be evaluated on the basis of a checklist. All items must be rated "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Test the water supply lines in a building with city water pressures.

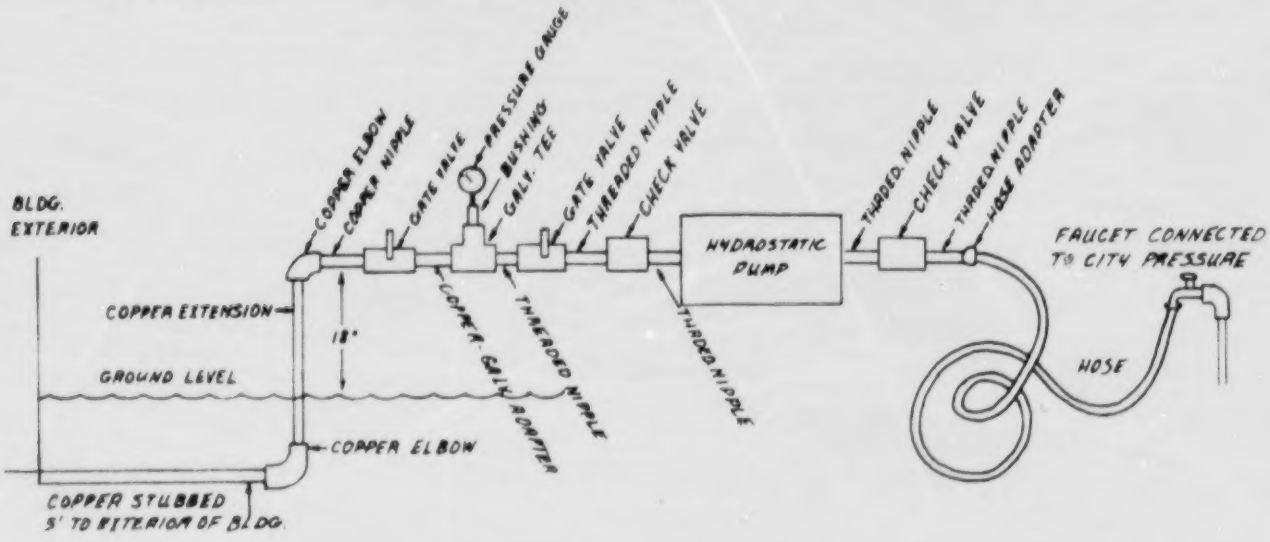
PERFORMANCE GUIDE:

1. Cap or plug all open water supply points in building.
2. Assemble testing apparatus similar to included diagram.
3. Connect testing apparatus at temporary water service valve.
4. Remove cap or plug from uppermost supply point–bleed air and recap.
5. Purge air from system, using bleed method.
6. Apply desired pressure to system, using pump.
7. Close gate valve nearest pump–observe gauge for pressure drop. (If drop occurs, check system for leaks).
8. If no drop in pressure has occurred, note pressure reading and close second gate valve.
9. Recheck in one hour by opening second gate valve and observing pressure drop.
10. Close both gate valves. Remove pump, allow system to remain pressurized 24 hours, and recheck.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Was test equipment correctly installed? ☐
2. Were all supplies capped or plugged? ☐
3. Were system checks made at correct intervals? ☐
4. Was the system bled correctly? ☐
5. Was the correct test pressure used? ☐



Duty: WATER SYSTEMS

Task: Insulate water lines

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70. Performance Objective

Describe pipe insulation of water lines.

Criterion-Referenced Measure

Describe a properly insulated hot water line.

Performance Guide

1. Describe the proper insulation of a hot water line from the hot water heater to a fixture.

Duty: WATER SYSTEMS

Task: Install water circulating pumps

71. Performance Objective

Given a hot water heating system and plumbing tools and supplies, install a water circulating pump in the system. Completed work must be approved by the instructor, using a checklist. The first 5 items must be rated "yes" for satisfactory performance.

Criterion-Referenced Measure

Install a water circulating pump in a hot water heating system.

Performance Guide

1. Determine space required for pump.
2. Connect water supply pipe leading to pump; cut threads on pipe end leading to pump and install half union.
3. Join nipple to pump inlet; install half union on nipple.
4. Connect nipple to pump outlet.
5. Join half union to nipple.
6. Thread end of pipe leading from pump and install half union.
7. Place pump in position.
8. Connect pump to inlet and outlet lines.
9. Call electrician for connecting electrical wiring to pump.
10. Test pump for proper operation.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. The first 5 items must be rated "yes" for satisfactory task performance.

1. Pump is in position specified by manufacturer. ☐
2. Pump operates properly when activated. ☐
3. Pipe joints do not leak when pump is activated. ☐
4. Finished work is neat in appearance. ☐
5. Trainee left work area clean. ☐
6. Work was performed within established time limit. ☐

Duty: WATER SYSTEMS

Task: Install lawn sprinkler system

72. Performance Objective

Given a water supply source, an outside area 50' x 20' and appropriate tools, describe the installation of a 2" diameter PVC pipe and sprinkler heads underground for lawn water service. Completed work must provide uniform coverage of the lawn area with water when the sprinkling system is activated.

Criterion-Referenced Measure

An outside area 50' x 20' has been marked off. Describe installation of a 2" PVC pipe and sprinkler heads for lawn water service within the marked area.

Performance Guide

1. Locate trench lines, considering desired amount of water overlap required for complete coverage.
2. Locate pipe, vertical tee and riser in trenches for each sprinkler head.
3. Locate supply line.

Duty: WATER SYSTEMS

Task: Inspect plumbing system

---

73. Performance Objective

Given a set of blueprints and building specifications, inspect a roughed-in water system for compliance with the contract. The inspection must cover pipe size used, location of piping, insulation drain line grading and vent line sizing and location. All work must be in compliance with the contract and must meet all applicable codes. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Inspect a roughed-in plumbing water system.

Performance Guide

1. Inspect vents and drain lines for compliance.
2. Inspect all water supply pipes for compliance.
3. Prepare report of inspection for instructor.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

Inspection covered all items listed below:

1. Layout planning ☐
2. Sizes ☐
3. Connections ☐
4. Elevation ☐
5. Venting ☐
6. Insulation ☐
7. ☐
8. ☐

Duty: PUMPS

Task: Install a well pump

---

74. Performance Objective

Given materials, equipment and instructions, install a domestic type water service pump in a simulated well situation. The work must adhere to existing codes and function to the instructors satisfaction. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Install a domestic type water pump in a simulated well situation using a "Extrol" pressure tank.

Performance Guide

1. Secure needed supplies, materials and equipment.
2. Assemble and mount equipment withfoot valve in open tank (simulated well).
3. Fill tank (simulated well).
4. Prime pump.
5. Make electrical connections.
6. Set pressure controls.
7. Start pump and check for leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Equipment properly assembled and mounted with footvalve in well. ☐
2. Pump primed correctly. ☐
3. Pump electrical connections correct. ☐
4. Pump cuts in and out at proper settings. ☐
5. Pump runs correctly. ☐
6. Joints and connections do not leak. ☐
7. ☐
8. ☐

Duty: PUMPS

Task: Install a sump pump

---

75. PERFORMANCE OBJECTIVE:

Given materials, equipment and instructions, install a sump pump in a simulated situation. The installation must be to the instructor's satisfaction and in compliance with existing codes. Completed work will be evaluated using the checklist.

CRITERION-REFERENCED MEASURE:

Install a sump pump in a simulated sump situation.

PERFORMANCE GUIDE:

1. Secure supplies and materials.
2. Assemble equipment and place in sump.
3. Pipe discharge to suitable termination.
4. Install check valve in discharge line.
5. Connect power and test.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Properly assembled and placed on sump. ☐
2. Check valve correctly installed. ☐
3. Electrical connections safe from shock. ☐
4. Pump functions correctly. ☐
5. System does not leak. ☐
6. Installation is in compliance with all codes. ☐
7. ☐
8. ☐

Duty: DISPOSAL SYSTEMS

Task: Septic tank and drain field installation

---

76. Performance Objective

Given the necessary information and specifications, describe the installation of a septic tank and drain field. The procedures and functions description must be to the instructor's satisfaction and must meet existing health requirements.

Criterion-Referenced Measure

Describe in writing the installation procedures and functions of a septic tank and drain field.

Performance Guide

1. Visit septic tank manufacturer.
2. Observe septic tank being cast or poured from concrete.
3. Visit site of actual septic tank and drain field installation.
4. Prepare written description.

Duty: DISPOSAL SYSTEMS

Task: Make sewer tap in vitrified clay sewer pipe.

---

77. Performance Objective

Given necessary tools, supplies and equipment make a sewer tap in a vitrified clay sewer pipe. The tap must be to the instructor's satisfaction, and in compliance with all codes and health requirements. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Make a sewer tap in a vitrified clay sewer pipe.

Performance Guide

1. Cut 4½" hole in clay sewer line with hammer and chisel.
2. Cut bell to proper length.
3. Cement bell into hole.
4. Wear safety glasses

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. 4 1/2" hole cut in clay sewer line using hammer and chisel. ☐
2. Bell cut to proper length. ☐
3. Bell cemented into hole. ☐
4. Work complies with all codes and health requirements. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: DISPOSAL SYSTEMS

Task: Public Sewer Classification

---

78. Performance Objective

Given proper instructional materials, identify and state purpose of sewers from house or building to disposal plant to the satisfaction of the instructor.

Criterion-Referenced Measure

Identify and state purpose of sewers from house or building to disposal plant.

Duty: INSTALLING FIXTURES

Task: Install bathtubs

79. PERFORMANCE OBJECTIVE:

Provided with the rough-in plumbing and access to plumbing tools, equipment and supplies, install a bathtub. The tub must rest firmly on the floor and against the wall, and it must be level. The trim must not be scarred. All joints must be leakproof. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a bathtub.

PERFORMANCE GUIDE:

1. Remove tub from crate, if necessary, and inspect for chips or other damages.
2. Set tub in place.
3. Install 2" x 4" support to wall, secure tub apron on support, and level tub.
4. Connect waste and overflow, coating topside of tub waste flange with plumber's putty.
5. Using slip nuts and washers, connect waste and overflow to drain line provided.
6. Using trim provided by manufacturer, connect escutcheons and handles on faucets provided.
7. Using correct length nipple, install diverter spout flush with finished wall.
8. Turn water on and check for leaks on water supply and drain line connections.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Tub properly supported and leveled. ☐
2. Waste and overflow properly connected to tub and stubbed out drain. ☐
3. Escutcheons and faucet handles properly connected. ☐
4. Diverter spout installed properly (flush with finished wall). ☐
5. All joints and connections do not leak. ☐
6. ☐
7. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: Install flush value-type water closets

80. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install a flush value-type water closet. Plumbing fittings must not leak and the bowl must rest securely on the floor. Chrome and procelain parts must not be damaged during the installation. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a flush valve-type water closet.

PERFORMANCE GUIDE:

1. Install closet collar, using lead and oakum joint.
2. Insert closet bolts into collar.
3. Place wax seal over closet collar.
4. Place closet bowl over drain outlet, inserting bolts through bowl holes provided.
5. Tighten closet bolts.
6. Using slip nut and washer, connect flush valve to bowl.
7. Using 1" chrome nipple for water line and chrome elbow provided, connect flush valve to water supply line.
8. Turn water supply on, flush water closet, and check operation of flush valve.
9. Adjust flush valve as required.
10. Check plumbing fittings for leaks.
11. Check bowl for stability; shim, if necessary.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Closet collar properly installed. ☐

2. Closet bolts placed in flange slots. ☐

3. Wax seal placed over closet collar. ☐

4. Closet bolts properly tightened (not too tight, so as to crack or break closet base. ☐

5. Water supply line properly connected. ☐

6. Flush valve properly adjusted. ☐

7. Joints and fittings do not leak. ☐

8. Commode sets level on floor. ☐

Duty: INSTALLING FIXTURES

Task: Install tank-type water closets

81. PERFORMANCE OBJECTIVE:

Provided with rough-in plumbing and access to plumbing tools, equipment and supplies, install a tank-type water closet according to the manufacturer's instructions. Finished work must be approved by instructor, using a checklist in which all items must be rated "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a tank-type water closet.

PERFORMANCE GUIDE:

1. Remove water closet, tank, and accessories from crate and check flush valve.
2. Place bolts in closet bowl collar used to bolt bowl to floor.
3. Place wax seal over closet bowl collar.
4. Place closet bowl over drain line and bolt closet bowl to floor.
5. Connect closet tank to closet bowl, using bolts, washers, and bushings provided. Tighten nuts on bolts alternately until washer exerts slight amount of pressure on bolts. Tank must be level on closet bowl.
6. Using water closet supply line, connect water supply line to closet tank.
7. Install closet bowl seat provided by placing bolts on seat through holes on closet bowl.
8. Tighten seat nuts carefully, so as not to crack ceramic closet bowl.
9. Turn water supply on and allow closet tank and bowl to fill.
10. Flush water closet and make adjustments on flush valve as required.
11. Check for leaks.
12. Place lid on closet tank.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Closet bowl and tank connections do not leak. ☐

2. Connections to water supply do not leak. ☐

3. Floor drain connection does not leak. ☐

4. Tank and closet bowl fill with water when water supply is turned on and after flushing. ☐

5. Bowl is secure to floor. ☐

6. Tank rests level on closet bowl. ☐

Duty: **INSTALLING FIXTURES**

Task: **Install built-in lavatories**

82. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install a built-in lavatory. Pipe connections and faucets must not leak. Chrome accessories must not be damaged, and sink must be level. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a built-in lavatory.

PERFORMANCE GUIDE:

1. Coat inside edge of rim with fixture sealant.
2. Fit lavatory into cavity.
3. Attach lavatory to rim, using clips provided.
4. Coat flange of pull-out plug with plumber's putty and set plug in lavatory.
5. Coat faucet flanges with plumber's putty and connect faucets to lavatory.
6. Using correct length lavatory supplies, connect water supply line to lavatory.
7. Using P-trap and 1¼" x 1½" slip joint nut, connect drain line to lavatory.
8. Turn on water supply and check connections and faucets for leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Fixture sealant correctly applied to inside edge of rim. ☐
2. Lavatory properly fitted into cavity. ☐
3. Lavatory attached to rim, using clips. ☐
4. Pull out plug, faucet flanges and faucets properly connected. ☐
5. Water supply and drains properly connected to lavatory. ☐
6. All excess putty etc. removed. ☐
7. Joints and connections do not leak. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: Install wall-mounted lavatories

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83. PERFORMANCE OBJECTIVE:

Provided with the rough-in plumbing and access to tools, equipment and supplies, install a wall-mounted lavatory. The lavatory must be installed in a level and sturdy position. Chrome fittings and faucets must not be scarred. Fitting joints must not leak, and water must drain freely. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a wall-mounted lavatory.

PERFORMANCE GUIDE:

1. Remove lavatory from crate, if necessary, and inspect for damage.
2. Determine height of installation.
3. Install hanger at correct height.
4. Connect lavatory faucets. Use plumber's putty between seat of faucets and surface of lavatory.
5. Using nuts and washers provided by manufacturer, tighten faucets snugly on lavatory.
6. Remove flange from drain plug and coat underside with plumber's putty.
7. Drop drain plug flange through lavatory drain hole.
8. Using material furnished by the manufacturer, tighten drain plug snugly in lavatory.
9. Secure lavatory on hanger previously installed.
10. Using correct length lavatory piping supplies, connect cold water supply to cold water side of faucets.
11. Connect hot water supply to hot water side of faucets.
12. Using 1 1/4" P-trap, and 1 1/2" x 1 1/4" slip nut and washer, install trap to drain line provided.
13. Turn water on and check for leaks in water supply and drain line connections.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Hanger installed at correct height. ☐

2. Faucets properly installed on lavatory. ☐

3. Drain flange and plug properly installed on lavatory. ☐

4. Lavatory securely fastened to hanger. ☐

5. Hot and cold supply lines properly connected to faucets. ☐

6. Drain line properly connected to lavatory. ☐

7. Supply and drain lines do not leak. ☐

8. ☐

Duty: **INSTALLING FIXTURES**

Task: **Install wall-mounted urinals**

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84. PERFORMANCE OBJECTIVE:

Provided with the rough-in plumbing and access to tools, equipment and supplies, install a wall-mounted urinal. The urinal must fit flush against wall and must be installed in a plumb position. Chrome fittings should not be scarred, and fitting joints must not leak. The fixture must flush correctly when flush valve is activated. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a wall-mounted urinal.

PERFORMANCE GUIDE:

1. Install drain bracket on drain line which has been stubbed out through wall.
2. If urinal has hangers, install hangers at correct height from finished floor.
3. If ceramic tile wall exists, drill hole through ceramic wall and use toggle bolts to bolt bracket to wall.
4. Bolt urinal to finished wall, using bolts and holes in the urinal provided by manufacturer.
5. Install flush valve, using chrome elbow and nipples provided by manufacturer.
6. Turn water on and adjust flush valve for correct water pressure.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Drain bracket properly installed on drain line. ☐
2. Hangers installed at correct height from floor. ☐
3. Urinal properly bolted to hangers. ☐
4. Flush valve properly installed. ☐
5. Flush valve correctly adjusted. ☐
6. Joints and connections do not leak. ☐
7. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: Install shower bath accessories in ceramic tile baths

85. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing and tool set, including strap wrench, install shower bath accessories in a ceramic tile bath. Completed work must be approved by the instructor, using a checklist. Each item must be checked "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install shower bath accessories in a ceramic tile bath.

PERFORMANCE GUIDE:

1. Place small amount of plumber's putty on control valve heads and shower pipe stub.
2. Attach shower head and valve to shower pipe.
3. Slide escutcheon onto shower pipe.
4. Attach shower pipe end to roughed-in wall stub.
5. Press escutcheon against wall covering hole and stub. (Putty will hold escutcheon in place.)
6. Place escutcheon over water control valves and press against wall.
7. Attach control valve handles with screwdriver.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Chrome finish of trim is not scarred. ☐

2. Faucet flange fits flush against finished wall and is leakproof. ☐

3. Shower pipe flange fits flush against finished wall and is sealed. ☐

4. Shower pipe and lead connections to water supply do not leak. ☐

Duty: INSTALLING FIXTURES

Task: Install kitchen sink

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86. Performance Objective

Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install a kitchen sink. Pipe connections and faucets must not leak. Chrome accessories must not be damaged, and sink must be level. Completed work will be evaluated using the checklist.

Criterion-Referenced Measure

Go to the rough-in plumbing and install a kitchen sink.

Performance Guide

1. Coat inside edge of rim with fixture sealant.
2. Fit sink into cavity.
3. Attach sink to rim using clips provided.
4. Coat flange of pull-out plug with plumber 's putty and set strainer baskets in sink.
5. Coat faucet flanges with plumber's putty and connect faucets to sink.
6. Using correct length sink supplies, connect water supply line to sink.
7. Using P-trap and 1½" slip joint nut, connect drain line to sink.
8. Turn on water supply and check connections and faucets for leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Chrome finish of trim is not scarred. ☐
2. Rim to sink and rim to counter top sealed . ☐
3. Faucets installed square to wall and sink. ☐
4. Supply lines properly shaped. ☐
5. No leaks in water supply or drainage connections. ☐
6. Mounting brackets properly spaced and tight. ☐
7. Strainer baskets puttied and properly seated in sink. ☐
8. Work area clean and tools returned to proper location. ☐

Duty: INSTALLING FIXTURES

Task: Install garbage disposal units

87. PERFORMANCE OBJECTIVE:

Provided a cabinet-mounted sink, a garbage disposal unit and appropriate tools and fittings, install the garbage disposal unit so that no joints leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Using correct procedures previously demonstrated by an instructor, install a garbage disposal unit under a cabinet-mounted sink.

PERFORMANCE GUIDE:

1. Remove sink tailpipe and loosen strainer.
2. Position disposal unit directly under sink drain.
3. Screw strainer into top of unit and secure with lock nut.
4. Insert fitting into disposal unit and attach trap with cleanout.
5. Secure both with lock nuts.
6. Inspect for leaks.
7. Call electrician for connecting power to unit.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Disposal unit positioned correctly under sink drain. ☐
2. Strainer secured with lock nut. ☐
3. All fittings properly installed and secured with lock nuts. ☐
4. Joints and drains do not leak. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: Install dishwashers

88. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing manufacturer's installation manual and access to plumbing tools, equipment and supplies, install a dishwasher. The dishwasher drain connections to the kitchen sink and water supply line must not leak. The drain line must prevent backfill from the sink drain line. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing beside a kitchen sink and install a dishwasher. You may use the manufacturer's installation manual.

PERFORMANCE GUIDE:

1. Remove cover from back of dishwasher, if required.
2. Identify hot water outlet on dishwasher.
3. Makeup and connect hot water line from dishwasher to hot water supply line, using copper tubing and fittings.
4. Install cut-off valve on hot water supply line.
5. Using dishwasher sink connector, install dishwasher drain line. (Drain line must have a loop to prevent sink drain backup into dishwasher.)
6. Replace cover on back of dishwasher.
7. Set dishwasher in place and level, using leveling legs provided on dishwasher.
8. Turn water supply on and cycle machine completely.
9. Check flow of water during cycle for obstructions and leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Hot water supply line properly identified and connected. ☐
2. Shut off valve installed in hot water supply line. ☐
3. Dishwasher drain line properly installed. ☐
4. Dishwasher properly set in place and leveled. ☐
5. Supply and drain lines do not leak. ☐
6. Dishwasher checked for proper operation i.e. cycles properly and drains completely. ☐
7. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: Install drinking fountains

89. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install a drinking fountain. The fixture must be in a sanitary condition and rest securely in place. The height and/or location of the drinking fountain must be within ± 1/2" of specifications. Connections must be leakproof, and the fountain must be in a level position. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a drinking fountain.

PERFORMANCE GUIDE:

1. Using 3/8" copper tubing and fittings, connect cold water supply line to drinking fountain.
2. Using 1 1/4" trap and 1 1/2" x 1 1/4" slip joint nut and washer, connect drain line to drinking fountain.
3. Mount fountain securely to wall, if wall-hung type.
4. Turn water supply on and adjust height of water flow on drinking fountain.
5. Level drinking fountain, if necessary.
6. Check all fittings on drain and water supply line for leaks.
7. Clean water fountain and working area.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Cold water supply properly connected. ☐
2. Drain line properly installed. ☐
3. Fountain properly mounted and leveled. ☐
4. Height of water flow correctly adjusted. ☐
5. All joints and fittings do not leak. ☐
6. Fountain and work area cleaned. ☐
7. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: **Install pressure relief valves**

90. PERFORMANCE OBJECTIVE:

Given a hot water heater and pressure relief valve, install a pre-set pressure relief valve on a hot water heater. The valve must be installed in a safe drainage position. Pipe joints must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

A hot water heater and a pressure relief valve are available for installation. Install the pre-set pressure relief valve on the hot water heater.

PERFORMANCE GUIDE:

1. Apply pipe sealant to male threads of one pipe stub atop heater (either hot or cold as determined by local codes).
2. Attach tee to stub and tighten with wrenches.
3. Using sealant and wrenches, attach nipple to top of tee.
4. Attach relief valve to nipple end and tighten, with relief valve opening positioned for desired direction of drain-off.
5. Attach drain pipe to relief valve opening.
6. Connect piping to tee for remaining water supply as determined in Step 1.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Relief valve installed in proper location. ☐

2. Drain pipe properly installed and run to termination point. ☐

3. All joints do not leak. ☐

4. ☐

5. ☐

6. ☐

7. ☐

8. ☐

Duty: INSTALLING FIXTURES

Task: Install electric water heaters

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91. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install an electric water heater. The plumbing must be installed so that the cover can be placed on the water heater and the heater elements and thermostats are easily accessible. All pipe joints must be leakproof. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install an electric water heater.

PERFORMANCE GUIDE:

1. Remove top from water heater.
2. Install relief valve from opening at top of water heater. Relief valve must be positioned according to safety regulations.
3. Connect hot water supply line to opening designated on water heater, including a dialectric union.
4. Install hot water line in channel provided at back of water heater.
5. Connect cold water outlet to cold water opening on water heater, including a union.
6. Install cold water line in channel provided at back of water heater.
7. Level water heater.
8. Turn on hot water faucet at kitchen sink and turn on water supply.
9. Fill water heater until water flows from hot water faucet in kitchen sink.
10. Cut off hot water faucet in kitchen.
11. Check hot and cold water supply lines for leaks.
12. Replace top of water heater.
13. Turn on electricity.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water heater properly located. ☐
2. Supply lines connected to proper tank outlets. ☐
3. Cut off valve installed in cold water supply line. ☐
4. Boiler drain located in proper position and closed ☐
5. Relief valve properly installed and drain line run to proper termination. ☐
6. All lines are secure and do not leak. ☐
7. ☐
8. ☐

Duty: INSTALLING FIXTURES

Task: Install gas water heaters

92. PERFORMANCE OBJECTIVE:

Given the rough-in plumbing and access to plumbing tools, equipment and supplies, install a gas water heater. Finished work must be approved by the instructor, using a checklist. All items must be rated "yes" for satisfactory performance. (1, @)

CRITERION-REFERENCED MEASURE:

Go to the rough-in plumbing and install a gas water heater.

PERFORMANCE GUIDE:

1. Locate relief value outlet on water heater and attach tee to stub.
2. Install relief valve.
3. Attach 3/4" galvanized line from relief valve to location of desired overflow.
4. Using nipple, elbow and union, install 3/4" galvanized line from heater to cold water supply line.
5. Using nipple, elbow and union, install 3/4" galvanized line from heater to hot water supply line.
6. Using 3" galvanized vent pipe, run vent through roof or wall. (Use double-wall pipe where vent extends through combustible material.)
7. If vent protrudes through roof, install 3" roof jack to prevent leaks around pipe outlet.
8. Place cap over vent pipe outlet.
9. Using pipe and fittings required, connect gas line to heater.
10. Turn gas supply on and check for leaks, using soap and water solution as leak detector.
11. Open hot water faucet in kitchen sink.
12. Turn water supply one.
13. Fill hot water tank until water flows from hot water faucet in kitchen sink.

PERFORMANCE GUIDE: Cont'd.

14. Cut off hot water faucet in kitchen.
15. Check hot water and cold water supply lines for leaks.
16. Light hot water heater and adjust burner flame, if necessary.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Vent pipe is positioned properly. ☐
2. Roof flashing prevents water leaks. ☐
3. Hot water heater burner flame is properly adjusted. ☐
4. Hot and cold water supply lines do not leak. ☐
5. Hot water heater is installed in a stable position. ☐
6. Relief valve outlet is properly installed. ☐
7. Heater is positioned for accessible maintenance. ☐

Duty: HEATING SYSTEMS

Task: Install water system components for hot water heating coils

93. PERFORMANCE OBJECTIVE:

Given black steel pipe, appropriate fittings, plumbing tools, and a description of the construction and installation requirements, construct and install the water lines for a hot water heating coil. The pipe must be free of obstructions, and the joints must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

A box simulating hot water heating coils has been positioned for you. Construct and install system components and water lines for the simulated coils.

PERFORMANCE GUIDE:

1. Connect pipe to main supply line.
2. Connect balancing valve in supply line.
3. Attach gate valve on return line.
4. Install gauge cock.
5. Connect thermometer well in return and supply line.
6. Install by-pass line into three-way valve.
7. Install unions as necessary.
8. Install drain tee.
9. Connect pipe out of coil and into return port on three-way valve.
10. Install strainer ahead of coil and three-way valve.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. All components properly located. ☐
2. All joints don't leak. ☐
3. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: HEATING SYSTEMS

Task: Install temperature and pressure relief valves on boilers

94. PERFORMANCE OBJECTIVE:

Given a boiler with a relief port, needed tools and equipment, install a temperature and pressure relief valve on a boiler. The valve must allow system/water release under a pressure and temperature test of the boiler. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Install a temperature and pressure relief valve on a boiler when provided the opportunity by your instructor.

PERFORMANCE GUIDE:

1. Attach temperature and pressure relief valve furnished by boiler manufacturer to relief port.
2. Connect pipe to valve and run to nearest drain opening.
3. Check relief of boiler water, using the manual trip lever.
4. Fire boiler to temperature and pressure required for activation of valve. Valve must relieve at pressure and temperature indicated.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Pressure relief valve properly located. ☐
2. Drain run to proper outlet. ☐
3. System check so that relief valve operates at correct temperature and pressure. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: Trouble shooting plumbing problems

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95. Performance Objective

Given a plumbing system with predetermined flaws, tools supplies and equipment, inspect, identify and correct all flaws in the system to the instructor's satisfaction. Completed work will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Identify and correct flaws in the plumbing system.

Performance Guide

1. Inspect plumbing system.
2. Identify flaws or problem areas.
3. Correct flaws using proper tools and procedures in:

    (a) Copper pipe
    (b) Galvanized pipe
    (c) PVC pipe

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. All flaws located. ☐
2. All flaws corrected. ☐
3. Work neat in appearence and work area cleaned up. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: Clear obstructions from lavatory drains

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96. PERFORMANCE OBJECTIVE:

Given access to plumbing tools, equipment and supplies, clear obstructions from a lavatory drain. A normal amount of water must flow through the lavatory drain. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Remove obstructions from a lavatory drain when requested by your instructor.

PERFORMANCE GUIDE:

1. Remove cleanout or drain stopper and check for obstruction. Remove any obstruction and check for proper drainage.
2. If problem is not solved, plug overflow opening with rag and force air and water through drain line with vacuum plunger.
3. If problem is not solved, rod out drain line with flexible cable and auger.
4. If limited amount of water is moving, pour caustic chemical into drain, using chemical manufacturer's instructions for proper application.
5. If problem still exists, disassemble, clean, and reassemble drain and P-trap.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Proper procedures followed in clearing drain line. ☐
2. Lavatory now drains freely. ☐
3. No leaks were created during cleaning procedure. ☐
4. Work area cleaned up. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: **Remove obstructions from main drain lines**

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97. PERFORMANCE OBJECTIVE:

Given a power-operated sewer auger and a caustic chemical, remove obstructions from a main drain line. The drain line must accommodate the normal amount of waste. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Remove obstructions from a main drain line when requested by your instructor.

PERFORMANCE GUIDE:

1. Identify cleanout opening in drain line. If none exists, remove appropriate fixture.
2. Attach proper size bit on end of rod.
3. Insert bit and rod into fixture drain line.
4. Bend rod as required to reach obstruction.
5. Activate power auger. Clean line, removing auger and cleaning as necessary.
6. If roots are present in drain, replace drain line.
7. Run water through line.
8. Repeat process until line is cleaned.
9. Replace fixture.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Proper size auger bit used. ☐
2. Power auger used according to instructions. ☐
3. Water flows freely through line. ☐
4. Clean out plug properly reinstalled. ☐
5. Fixture properly replaced. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: **Remove obstructions from water closet drains**

98. PERFORMANCE OBJECTIVE:

Given a vacuum plunger and flexible hand auger, remove obstructions from a water closet drain. The water closet must flush without overfilling. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Clear obstructions from a water closet drain when requested by your instructor.

PERFORMANCE GUIDE:

1. Force water through the water closet drain, using a vacuum plunger.
2. Flush water closet.
3. If problem still exists, rod out drain with flexible cable and auger.
4. Remove auger from drain, pulling obstruction with auger.
5. If obstruction cannot be removed with auger, pull water closet and remove obstruction from drain.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Vacuum plunger correctly used. ☐
2. Auger used if required. ☐
3. Water closet flushes without overfilling. ☐
4. Fixture replaced correctly, if removed. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: **Replace lavatory trap drains**

---

99. PERFORMANCE OBJECTIVE:

Given an adjustable jaw wrench, replace a faulty lavatory trap. Time limit is 15 minutes. When completed, the lavatory trap must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Replace a faulty lavatory trap. Needed tools and equipment will be supplied.

PERFORMANCE GUIDE:

1. Disconnect slip-joint nuts at lavatory trap.
2. Replace lavatory trap, using complete kit provided by manufacturer and other necessary materials.
3. Check for leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Lavatory trap correctly removed. ☐

2. New trap properly installed according to manufacturers instructions. ☐

3. New trap doesn't leak. ☐

4. Work completed with time limit. ☐

5. ☐

6. ☐

7. ☐

8. ☐

Duty: REPAIR AND MAINTENANCE

Task: Repair leaking shower valves

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100. PERFORMANCE OBJECTIVE:

Given an adjustable wrench and a valve seat wrench, repair a leaking shower valve. When completed, the shower valve must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Repair a leaking shower valve.

PERFORMANCE GUIDE:

1. Cut off water supply to valve.
2. Remove valve stem.
3. Remove valve seat using valve seat wrench, and replace with new one.
4. Remove washer on end of stem and replace with new washer.
5. Reassemble stem in body of shower valve.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water supply properly cut off. ☐
2. Valve seat properly removed and replaced. ☐
3. New washer properly installed. ☐
4. Shower valve properly reassembled. ☐
5. Repaired valve functions properly and doesn't leak. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: **Repair leaking water faucets or valves**

---

101. PERFORMANCE OBJECTIVE:

Given a strap wrench, screwdriver, knife, washers and a seat-dressing tool, repair a leaking water faucet. The faucet must not be marred by plumbing tools, and it must not leak after repair. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Repair a leaking water faucet.

PERFORMANCE GUIDE:

1. Shut off water supply to faucet.
2. Turn faucet handle to open faucet.
3. Unscrew faucet cap, using a strap wrench.
4. Remove spindle to expose washer.
5. Remove brass center screw.
6. Lift washer with knife tip.
7. Replace washer with new one and tighten.
8. Replace packing washer between cap nut and spindle as follows:
   a. Remove cap nut and spindle.
   b. Remove handle from top of stem.
   c. Replace packing washer.
9. Dress faucet ground seat as follows:
   a. Insert seating tool in faucet and press threaded cone down into body opening.
   b. Center spindle and cutter in faucet.
   c. Using moderate downward pressure, rotate handwheel to right to dress seat.
10. Reassemble remaining parts.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water supply proptely shut off. ☐
2. Faucet properly disassembled. ☐
3. Faucet not damaged or scarred. ☐
4. Valve seat properly dressed. ☐
5. Washer properly replaced. ☐
6. Faucet properly reassembled. ☐
7. Faucet operated correctly and doesn't leak. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: Repair Ball Cock Valve

---

102. PERFORMANCE OBJECTIVE:

Given access to tools, equipment and supplies, repair ball cock anti-syphoning valve. Repaired valve must not leak.

CRITERION-REFERENCED MEASURE:

Repair ball cock anti-syphoning valve.

PERFORMANCE GUIDE:

1. Shut off water at fixture cut off.
2. Remove tank top.
3. Check water level and flow.
4. Disassemble valve.
5. Check valve seat and washers.
6. Clean and smooth rough parts.
7. Replace valve seat and washer if needed.
8. Check for correct operation and leaks.

Duty: REPAIR AND MAINTENANCE

Task: Repair Diaphram-type Valve

---

103. PERFORMANCE OBJECTIVE

Given Necessary tools, equipment and supplies repair a diaphram-type valve on a water closet. Completed work will be evaluated using the checklist.

CRITERION-REFERENCED MEASURE:

Repair a diaphram-type valve.

PERFORMANCE GUIDE:

1. Shut off water at fixture cut off.
2. Empty flush tank.
3. Remove tank.
4. Remove intake valve.
5. Reseat new washer.
6. Replace intake valve.
7. Turn on water.
8. Check for leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water shut off at fixture cut off. ☐
2. Upper chamber lid removed. ☐
3. Rubber diaphram removed. ☐
4. Diaphram checked for defects. ☐
5. By-pass tube checked. ☐
6. Valve operates properly and doesn't leak. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: **Install a prefabricated air chamber.**

---

104. PERFORMANCE OBJECTIVE:

Given access to tools, equipment and supplies, install a prefabricated air chamber in a water supply line. When completed, the air chamber should suppress all noise caused by water hammer. Joints must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Install a prefabricated air chamber in a water supply line.

PERFORMANCE GUIDE:

1. Determine location of noise.
2. Obtain access to water supply line.
3. Determine size air chamber required for line.
4. Cut off water supply.
5. Cut line at point where chamber will be installed.
6. Install tee in cut line.
7. Install air chamber at most distant point of termination.
8. Turn water on and test for water hammer.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the pe formance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Location of noise found. ☐

2. Air chamber size needed was determined. ☐

3. Water supply cut off. ☐

4. Air chamber installed in proper position and location. ☐

5. All joints and connections don't leak. ☐

6. Checked for noise coused by air hammer. ☐

7. ☐

8. ☐

Duty: REPAIR AND MAINTENANCE

Task: Replace pressure control switches on water pumps

---

105. PERFORMANCE OBJECTIVE:

Given a screwdriver and a set of open-end wrenchs, replace a malfunctioning pressure control switch on a pump. The new switch must function to provide an amount of water at a pressure level designated by the pump manufacturer. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Replace a defective pressure control switch on a pump.

PERFORMANCE GUIDE:

1. Remove cover from control switch.
2. Turn water on and check opening and closing of switch points.
3. If switch contacts do not disengage, replace switch as described in following steps.
4. Turn off power supply.
5. Disconnect wiring on switch, observing carefully correct location of wire leads on switch.
6. Remove switch from pump.
7. Install new switch on pump and connect wire leads on switch.
8. Turn on power supply and check operation of pump.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Opening and closeing of points checked. ☐
2. Remove switch from pump if needed. ☐
3. Replace switch if needed. ☐
4. All wiring checked and tight. ☐
5. Pump operation checked. ☐
6. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: **Replace a section of galvanized water supply line**

---

106. PERFORMANCE OBJECTIVE:

Given a four-wheel cutter, pipe wrenches, pipe nipple, half unions, pipe vise, reamer, pipe sealant and pipe threaders, replace a water supply line installed horizontally underneath a raised floor. The completed pipe joints must not leak. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Your instructor will arrange for you to replace a section of galvanized water supply line which is installed horizontally underneath a floor.

PERFORMANCE GUIDE:

1. Turn off water supply.
2. Cut pipe at desired location, using four-wheel cutter.
3. Remove pipe to be replaced from fitting, disconnecting hangers, if necessary.
4. Assemble nipple and half union and connect to fittings in supply line.
5. Measure, cut, and thread replacement pipe, allowing for fittings.
6. Connect unions.
7. Turn on water supply and check for leaks.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Water supply cut off. ☐
2. Pipe properly cut ☐
3. All pipe ends properly threaded. ☐
4. All joints and connections properly tightened. ☐
5. All joints and connections don't leak. ☐
6. All pipe hangers replaced as needed. ☐
7. ☐
8. ☐

Duty: REPAIR AND MAINTENANCE

Task: Thaw Frozen Pipes

---

107. PERFORMANCE OBJECTIVE:

Given an exposed frozen steel water supply pipe, torch and necessary materials, thaw the pipe. Water must flow freely through the pipe after thawing. Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Your instructor will provide you with a situation involving a frozen water pipe. Thaw the pipe with a plumber's torch.

PERFORMANCE GUIDE:

1. Locate frozen area of pipe.
2. Open faucet or valve.
3. Light torch and adjust flame.
4. Apply heat in a back and forth motion over entire length of freeze. Take precautions against fire.
5. Continue step 4 until water runs freely through lines.
6. Remove torch and extinguish flame.
7. Allow water to flow for several minutes to avoid refreezing.
8. Close faucet or valve.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Frozen area correctly located. ☐
2. Valve or faucet opened. ☐
3. Torch correctly lighted and adjusted. ☐
4. Heat properly applied to frozen area. ☐
5. Torch properly shut down. ☐
6. Water flows freely through pipe. ☐
7. Valve or faucet closed. ☐
8. No damage done to pipes and surroundings. ☐

Duty: ESTIMATING

Task: **Compute the costs for plumbing supplies**

---

108. **PERFORMANCE OBJECTIVE:**

Provided with a blueprint and job specifications for a two-bath house and materials cost sheets from a manufacturer, compute the cost for piping, fittings and fixtures in the bathrooms and kitchen. The total cost must be within ± $10.00 of the instructor's computation. (1)
Completed work will be evaluated using the checklist. (1)

CRITERION-REFERENCED MEASURE:

Compute the cost for piping supplies and fixtures for two bathrooms and kitchen. You may use the blueprint, job specifications, and cost sheets provided by your instructor.

PERFORMANCE GUIDE:

1. The instructor will indicate the starting point in the bathroom and kitchen. The student will make a materials list with prices and total the costs for materials.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. Materials list complete. ☐
2. Prices for materials is correct. ☐
3. Calculations are correct and within ± $10.00 of instructor's figures. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

Duty: ESTIMATING

Task: Plumbing fixture and supplies inventory

---

109. Performance Objective

Given a storage area and necessary supplies and fixtures, complete a manual inventory to the satisfaction of the instructor. Completed list will be evaluated using the checklist. (1)

Criterion-Referenced Measure

Manually inventory supplies and fixtures.

INSTRUCTOR CHECKLIST

INSTRUCTIONS: If the performance is satisfactory, write **YES** in the space provided. If the performance is unsatisfactory, write **NO** in the space. Each item must be rated "yes" for satisfactory task performance.

1. All supplies and equipment properly identified and checked. ☐
2. Accuracy to instructors satisfaction. ☐
3. ☐
4. ☐
5. ☐
6. ☐
7. ☐
8. ☐

APPENDIX A

Equipment by Percentage Rating

Equipment Description	Percentage of Members Using	Number of Members Using
Screwdrivers, Assorted	97.40	150
Hand Hacksaw	96.75	149
Pliers, Assorted	95.45	147
Wrenches, Assorted	95.45	147
Folding Rule	94.81	146
Chisels, Assorted	94.16	145
Hand Pipe Threaders	94.16	145
Hand Pipecutters and Reaming Tools	94.16	145
Ladders	94.16	145
Pipe-Threading Dies	94.16	145
Pipe Vise	92.86	143
Tube Cutter or Reamer	92.86	143
Files, Assorted	92.21	142
Portable Air or Electric Drills	92.21	142
Flaring Tool and Block	91.56	141
Shovels, Assorted	91.56	141
Plumb Bob	87.01	134
Hand Drills and Bits	86.36	133
Hand Saws	85.06	131
Caulking and Packing Irons	84.42	130
Pipe Taps	83.77	129
Retractable Steel Measuring Tapes	83.77	129
Plumber's Ladle	81.82	126
Punches, Assorted	81.82	126
Propane Torch	80.52	124
Portable Circular or Sabre Saws	78.57	121
Chalk Line	75.32	116
Spirit Level	72.08	111
Soldering Irons	71.43	110
Vacuum Plunger	71.43	110
Augers, Hand	70.78	109
Pedestal and Bench Grinders	69.48	107
Powered Pipe-Cutters, Threaders and Reamers	68.18	105
Chain Vise	67.53	104
Portable Power Saws	66.88	103
Melting Furnace	66.23	102
Oxyacetylene Torch	65.58	101
Carpenter's Square	62.99	97
Hand Shears	62.99	97

Equipment Description	Percentage of Members Using	Number of Members Using
Scaffolds	61.04	94
Strap Wrench	60.39	93
Swaging Tools	59.09	91
Portable Grinder	57.79	89
Combination Square	55.84	86
Framing Square	55.84	86
Mattock Pick	55.84	86
Marking or Scratch Awls	52.60	81
Electric Arc Welder	50.00	77
Chain Tongs	45.45	70
Slings and Hoists	44.81	69
Power Rodding Equipment	44.16	68
Scriber	40.26	62
Hot Air Torch	39.61	61
Metal Scrapers	38.96	60
Personnel Hoists or Lifts	35.71	55
Transit and Tripod	35.06	54
Calipers	28.57	44
Circumference Rule	26.62	41
Dividers or Trammels	20.78	32
Inert-Gas Metal-Arc Welder	19.48	30
Orifice Meter	16.88	26
Bending Block and Pins	13.64	21
Total Respondents	154	

Tools and Equipment Added After Survey

Spring-Type Tubing Bender
Turnbuckles and Clamps
Joint Runners
Hammers, Assorted
Putty Knife
Air Compressor and Attachments
Test Pumps

APPENDIX B

List of References

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3. Building Waste Systems: Plumbing Specialist. Department of Civil Engineering Training, Air Training Command, Sheppard Air Force Base, Texas 76311, 1974

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5. Installation Suggestions for No-Hub Pipe and Fittings. Cast Iron Soil Pipe Institute, 2029 K Street, N.W., Washington, D.C. 20006

6. Plumbing I: Waste Systems. Memorandum 541. U. S. Army Engineering School, Fort Belvoir, Virginia 22060, 1974

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State-of-the-Art Literature

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11. Publications Catalog. National Sanitation Foundation, NSF Building, Ann Arbor, Michigan 48105.

12. Southern Standard Plumbing Code. Southern Building Code Congress, 3617-8th Avenue, South, Birmingham, Alabama 35222.

13. Publications - Film Services. Copper Development Association, Inc., 405 Lexington Avenue, New York, New York 10017.

14. Filmstrips and Other Training Aids. American Standard Training Center, 16 John Street, Princeton, New Jersey 08540.

APPENDIX D

PLUMBING REFERENCE BOOKS

1. National Plumbing Code. McGraw-Hill Company Inc., New York, New York.

2. Southern Standard Plumbing Code. Southern Building Code Congress Int. Inc., 3617 Eighth Ave. South Birmingham, Ala. 35222.

3. Plumbers and Pipe Fitters Library. Audel, Howard W. Sans & Co. Inc., 4300 West 62nd. Street, Indianapolis, Ind. 46206.

4. How to Design and Install Plumbing. Mathias & Smith, American Technical Society, Chicago, U.S.A.

5. Plumbing I & II. Slater, Delmar Publishers, Mountain View Ave., Albany, New York 12205.

6. The Encyclopedia of Household Plumbing Installation and Repair. Martin Clifford, Drake Publishers Inc., 801 2nd. Ave., New York, New York 10017.

7. Mechanical Contractor Association of South Carolina. 2000 Laurens Street, Columbia, S.C.